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October 1971
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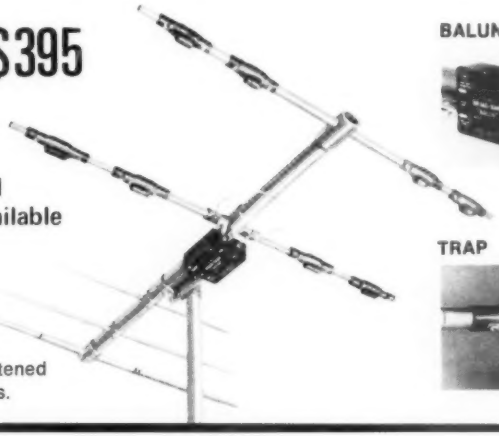

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73 MAGAZINE

#133 OCTOBER 1971

FEATURES

2 Radio Amateur News Page
6 Never Say Die W2NSD/1
8 DX Footnotes
9 Novice
10 Letters
13 Repeater Update
14 Caveat Emptor
22 Correction
111 Heath's Transverter
112 Propagation Chart
112 Advertiser Index

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CONTENTS

15 Wide-Range RF Milliwattmeters Using HCD's **W6AJF**
Using Hot Carrier Diodes!

23 Signalling Through Space Without Wires **K1CLL**
How it all got started.

29 An Instant FM Repeater for Emergency Use **K2OAW**
Two FM rigs - one repeater.

31 It's the Real Thing **VE3GSP**
Power supply not using transformers.

37 Meteor Showers: On Prediction Accuracy **W5KHT**
WAS on two meters? Why not?

41 Simple Digital Remote Control Circuits **W1EZT**
Doing lots with few wires.

49 How to Be An Amateur **W2ZGU**
A good amateur is ignorant, egocentric, etc...

55 A Simple Reverse Current Battery Charger **W6FPO**
For recharging flashlight batteries.

59 It's In the Bag **WB6JLC**
Almost.

61 Passive Repeaters **W7EEX**
And you can rent out the front for a billboard.

75 Converting the AC/DC for WWV **W3JJU**
Keep WWV at hand to check your calibrator.

77 Fail Safe Switching **W7CJB**
Infallible sequential switching

79 Back to Mother Earth the Easy Way **WA1FHB**
Installing a 10' ground pipe – easily!

81 3 dB for 3 Bucks **W2EEY**
Audio tailoring for SSB.

85 The Ham's Publicity Primer **WB2FBF**
Spreading the word.

101 Some Notes on the Swan 350 ..... **K1KXA**
Six improvements for a great rig.

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Run your fingers, do not walk them, through the pages of 73 and alight at the other end of the magazine wherein you will disover the reader's service department. Please do not try and hold yourself back from sending this in, suitably checked, requesting information from the fabulous people who make this magazine possible: the advertisers. Find out more about their products; buy them. The more gear you buy the more fun you're going to have, and the wife can buy that new coat next year, right? May we suggest a diet? You've been getting a bit paunchy lately, haven't you? And you could easily have a ball on FM with the money you'll save. So send in that coupon right away . . . or a copy of it, and let our advertiers know that you've started on that diet.

Cover: Posterization of the Regency HR-2A FM transceiver as cooked up by Roger Block.

Amateur Radio

OCTOBER MCMLXXI Monthly Ham Nev

REVERIE SAILS

K. M. Raupach WA4CYX

July 3, 1971, was the beginning of a spirited adventure, an idea which had been germinated several years ago by "Tex," K4MJZ (William B. Zammit) Often you hear people talk about buying a boat and "taking off" for a year or so, but how many of these dreams actually materialize? Well, in Tex's case they have.

I had the good fortune of meeting Tex several years ago as a result of ham radio, what else? I can't recount the many pleasant times we have had since, in fact every one that has ever been associated with Tex has said the same thing. The thought of taking a world cruise, leisurely, fanned my enthusiasm as much as it did Tex's, and as the years went by the idea began to gel to some degree of consistency. It has to be admitted that during this time there were misgiving thoughts about the project but with determination the plan was finally culminated. The problems, were, in many instances, gigantic, like selling a house and all the furniture plus other miscellaneous things including radio equipment that he thought he might need some day. All this had to go, as a boat just couldn't possibly hold it all. More compelling was finding the right boat, at the right price, and outfitting it. Tex accomplished all this with success. I was happy to have had a hand in some of this and acted in the capacity of backup support. I guess we all need that at times. Finally, the day came when Tex said, "I found my boat." When I first saw his boat, well, it's hard to describe the feeling, because I knew he had the right one. Now came another problem, renaming her. After much thought and head-knocking, the name *"Reverie"* came through. Webster in one instance describes *Reverie* as a "dreamy, fanciful or visionary notion or daydream." Tex thought this was great because this was one daydream that came true. I had to agree.

Following the purchase of the boat came the hull painting, stocking up of supplies and material, plus correcting

a number of things and taking numerous shakedown cruises on the Chesapeake Bay. Some of these were cold, wet days, some shrouded by fog, and others were just too pleasant to describe, especially watching the sun go down and then sailing under a bright moon, with a fair breeze. During all this time, Tex was practicing up on his navigation and acquiring what seemed to be bushels of charts – so necessary for the journey ahead. A few months before Tex sailed, I had to travel and couldn't get to Annapolis, Maryland, where the *Reverie* was berthed. On those weekends that I did manage to get there, we always headed out. During the last few weeks before departure, Tex told me he was busier than a "cat on a hot tin roof" and you can believe that, since the magic day was drawing closer.

The weekend of July 3rd was approaching. Being out of town, I was getting a little jumpy, as I had to be there when Tex left. With some luck, I did make it, and Saturday morning turned out to be beautiful. The sun was shining bright, the sky was clear, with a few cumulus clouds scattered around. Most of all, the breeze was just right – so necessary for a sailboat. I arrived at the dock at 10 a.m. and at that time there were quite a few people gathered. The *Reverie* was decked out in all her splendor, with flags flying. What a colorful sight she was. Tex and his shipmate, Steve Titus, were busy making last-minute preparations and welcoming everyone aboard.

Perhaps this is the time to make mention of Steve, not that he was neglected before. Steve is a fine young fellow who realizes that an opportunity of a lifetime has been presented to him. He really appreciates it, too. I had time to observe Steve during some

News Pages

FLASH FROM GENEVA

Despite attempts to open up 50, 220 and 1250 MHz for amateur satellite communications, The World Administrative Conference on Space Telecommunications has authorized amateur radio satellite communications on the following bands: 7.0–7.1, 14.0–14.25, 21.0–21.45, 18.0–29.7, 144–146, 435–438 and 24000–24050 MHz. Attempts to open up 50–54, 146–148, 220–225, more of 420, 1250–1300, etc., were frustrated. Since only the 144–146 MHz allocation was authorized previous to the meeting, we did not come away empty handed. But it is a shame that we were not better prepared to hold our UHF allocations since with satellites these bands should soon become world-wide bands. With synchronous satellites on the 1250–1300 MHz band hundreds of thousands of amateurs could QSO each other through the flying FM repeaters. Well, perhaps we can get started on the nice 50 MHz band they gave us up at 24000! That's just below light waves, isn't it?

Future Citizens To Be Licensed

The Goldwater-introduced Senate Bill 485 which would permit future citizens of the U.S. to get amateur radio licenses has been passed both by the House and Senate and awaits only a Presidential signature for enactment. This is indeed good news to many foreign amateurs in our country who are awaiting their citizenship.

ENGWICHT AWARD ANNOUNCED

San Jose, Cal. – The first Harry Engwicht Memorial Award has been presented to Philip E. Deaver, WB6QLZ, of Hayward, Cal.

The scholarship, which is $200 this year, is to be awarded annually to a junior electrical engineering student at San Jose State College on the basis of scholarship, eligibility to hold an amateur radio license, and membership in the I.E.E.E.

The late Harry Engwicht established a radio engineering department at San Jose College in 1934 and taught communication and electronic engineering there until his death in 1969. He was a pioneer in amateur radio, holding the call W6HC.

of the shakedown cruises, and he is the type of fellow, in my opinion, who "turns to." He very rarely has to be told what to do, and he watches the every move of the *Reverie*. After watching him, you quickly realize that within the short period of time he has been aboard the *Reverie* he has become a living, breathing part of her. Steve isn't a ham yet, but I'm willing to wager that before this voyage is over he will be fully qualified, if I know Tex. They will have time for that theory study and code practice, believe me.

Back to departure. More people gathered. Steve's mother and other relatives, friends of Tex's, including his former boss, and other people at the dock who couldn't help but realize that something special was up. Tex being the enterprising guy that he is, broke out a bottle of wine that had a neck on the bottle four feet long. Much to my surprise, it happened to be one that I had given him two years before as a gift, and at that time he said, "I'm going to have to save it for a special occasion." What could be more special than this? Even pouring from a container of this proportion proved to be somewhat of a chore, but with the able assistance of a lovely brunette, Jeanie Clarkson, the job was competently completed. Tex polished off the remainder by elevating that thing in the air only after everyone toasted Tex and Steve to a happy and successful voyage.

The departure hour arrived – streamers began to fly over the stern of the *Reverie* and Tex and Steve had their share draped over them, too. They climbed aboard and Tex started the auxiliary engine. The moorings were slipped, and at exactly 12:13 p.m., July 3, 1971, the *Reverie* cleared her berth, heading out the channel to the Chesapeake for a world cruise for amateur radio.

Ned Lentz, WA3EXE, and his lovely wife, Pat, were there with their 38 ft cabin cruiser *"Indolentz II."* We climbed aboard and followed Tex and Steve out. Once out in the bay, Tex and Steve removed the sail cover and hoisted the main, followed by the big jenny. The light breeze quickly filled those beautiful sails, then Tex brought the *Reverie* around to a true course south, and she responded like the perfect lady she is. Several times we pulled up next to Tex and shouted messages back and forth. I said to him, "I wish I were going with you." His reply was, "I wish you were, too. This is the greatest day of my life."

As you can guess, camera shutters were clicking furiously. We followed the *Reverie* out to buoy 73 and knew this would really top the performance. Tex made some runs for it, so that we could get more pictures. Finally he said, "It's time to get back on course." So with that, the *Reverie* "came about" and with arms waving, shouts of "good luck" and "smooth sailing," we in the *"Indolentz II"* turned and headed back to Annapolis. I watched the *Reverie* until she was out of sight and said to myself, "I'll be joining you soon."

If all goes well, I plan to meet Tex and Steve at Mayaguana, BWI, during the latter part of August. We will be on the air with gusto and looking for those contacts. During Tex's and Steve's travels they will be coming up on 14.295 and 21.350 about 10 a.m. every morning, providing they aren't having any problems with weather.

Left to right, Steve and Tex.

ILLINOIS HAM-OF-THE-YEAR

Photo by Jordan Kaplan W9QKE

Elmer P. Frohardt, Jr., W9DY, is presented with the 1971 Illinois Amateur of the Year Award by Ralph King (K9YSH), President of Hamfesters Radio Club, sponsors of this award, at their 37th annual hamfest held August 8 in Sante Fe Park, near Chicago.

W9DY has been licensed since 1939, and devotes a great deal of his time teaching and helping young people obtain their amateur radio licenses. He is on the DX Honor Roll, a member of The Intruder Watch, a long-time official observer, President of the Radio Amateur Megacycle Society, and former president of the Northern Illinois DX Association. He holds the amateur Extra class license, the 2nd class commercial telegraph license, and the 1st class commercial phone license. He works as a radio operator for the Illinois State Police.

CLEGG BOUGHT

E.T. Clegg Associates, E. Hanover, N.J., has recently been acquired by International Signal and Control Corporation, Lititz, Pa. The entire Clegg facilities have been moved to ISC's modern two-plant facilities at the new location. Mr. Clegg, W2LOY, has joined ISC as Director of Communications Research, Clegg Division. Among his staff of development engineers are Dick Somes, W3DNV, and Bob Witmer, K3VAX.

Mr. John Kryder, VP for sales, stated that "The Clegg Division will concentrate on the continued development and production of high quality VHF and UHF (AM/FM and SSB) equipment, with a heavy emphasis on customer service. The Clegg Division will also continue service on the ZEUS, INTERCEPTOR, 99'er, THOR, VENUS, 66'er, APOLLO, and VENUS SS BOOSTER equipments. Users should, however, write ISC describing the failure or problem prior to returning a unit to ISC to ascertain the availability of repair parts. Instruction manuals on all of the above equipment will be provided by ISC at a price of $5 each."

CORRECTION

IC Audio Processor, July page 16.

The B+ bus goes only to #2 on the first IC and #4 on the second, and nowhere else.

WITH THE FCC

Foreign Operator Permits Granted

The FCC announced the granting of 55 operator's permits to alien radio amateurs. The permits allow temporary (up to one year) operation of an amateur radio station within the United States. Twenty-two nations were represented in the group, and Canadian amateurs were not included in the list. Aliens wishing to operate in the U.S. should apply to the FCC, using Form 610A.

FCC Retirees Active

Many former FCC employees can still be found conversing among themselves on three separate nets. Along with well over a dozen former FCCers, the nets are often joined by many former commercial broadcasters. Besides a strictly CW FCC net, there is the "Old Goats Net" on 7210 kHz and the "Seven Day Weekenders Net" on 14285 kHz.

AMA & CBERS BACK EYEBANK NET

Both the House of Delegates of the American Medical Association and the national headquarters of REACT have announced to the FCC their support for a revision of the amateur regulations to allow greater ham involvement in behalf of non-amateur organizations.

The FCC is presently conducting an inquiry into the use of amateur radio stations for non-amateur organizations. In particular, the major question seems to be whether hams should be allowed to use amateur radio for the Red Cross, Eye Bank Association, March of Dimes, local service clubs, and similar public-spirited groups.

REACT – the National Citizens Radio emergency public service organization – issued a statement narrating the history of ham and CB cooperation during recent natural disasters. The statement continued with:

"REACT recognizes the outstanding public service contributions made through the years by amateur radio in the public service communications area and most strongly supports the contention that such activities should be permitted and encouraged in behalf of radio amateurs and the American public."

The AMA declaration also documented the amateur's traditional record of outstanding service in saving lives and providing health care services, both on a daily basis and in times of emergency.

However, the AMA proposal authored by Dr. John B. Dillon, WA6EWV, of the UCLA Medical School, would seem to remove the question from one of amateur frequency use. The AMA proposes the allocation of a special band *outside* of the regular ham bands solely for use by approved organizations in health care service. The AMA proposal made no other comment on the use of actual ham frequencies nor on non-health related groups such as Scouting, Kiwanis, and municipal organizations.

The AMA resolution is reprinted from *Worldradio*:

Whereas Amateur Radio through individuals or clubs has rendered valuable and frequently life-saving service in assisting the provision of health care services through consultations, acquisitions of equipment and medicine, and other vital activities, as illustrated by the long existing Eye Bank Net and activities of the Red Cross during disasters as a purely public service with no monetary considerations, and frequently at considerable personal expense; and

ARMED FORCES COMMUNICATIONS TEST RESULTS

This year's annual Armed Forces Day Communication Tests sponsored by the Department of the Army, Navy and Air Force once again proved to be a highly successful event.

Five military radio stations, WAR (Army), NSS (Navy), NØNNN (Navy), and AIR (Air Force) located in the Washington, D.C. area; NPT (Navy) in San Francisco; and NSSAM/NPGAM (Navy aircraft East and West coast) and an Air Force aircraft East Coast conducted the communication tests on 15 May 1971. The tests included military-to-amateur crossband operations and receiving contests for both continuous wave (CW) and radioteletypewriter (RTTY) modes of operation.

There were 467 perfect entries for the 60 word per minute RTTY message originated by the Secretary of Defense. A Certificate of Merit has been mailed to all those individuals who submitted a perfect contest entry. It should be noted that there were more perfect radioteletypewriter contest entries than CW, demonstrating the increasing competence of the amateur radio operator in this mode of operation.

Whereas the need for providing medical assistance locally and internationally through all possible facilities is clearly apparent and incontestable; and

Whereas newer techniques particularly that of utilizing satellites have and will, in the future, free up previously occupied high frequency channels;

Therefore, be it resolved that the House of Delegates of the American Medical Association indicate to the Federal Communications Commission their support of the concept of the allocation of a special band of frequencies outside the Amateur bands to be used be duly licensed radio amateurs for the sole purpose of assisting in the providing of health care service particularly in emergencies through organizations and clubs such as Red Cross, Eye Bank Net, Radio Clubs associated with Medical Schools and the Medical Amateur Radio Council, Ltd. or other groups duly approved on application for such activities by the Federal Communications Commission.

WASHINGTON TOWER CASE

Sequence of events:

7-3-70	WA7GQC applied for building permit to City of Everett (WA) for erection of 90 ft ham tower and beam. Denied because of 35 ft zoning restriction.
7-17-70	Applied for variance to exceed 35 ft. restriction.
8-3-70	Board of Adjustment postponed decision. WA7GQC hired attorney.
9-14-70	Variance denied. (Neighbors objected, height not necessary, unsightly.)
9-15-70	Requested reconsideration.
10-5-70	Variance denied. (35 ft limitation is not undue hardship on hams.)
10-15-70	WA7GQC advised city he was filing suit.
11-9-70	City Attorney and Assistant City Attorney decided restriction was not legally applicable to hams. City issued building permit. Suit dropped.
11-25-70	WA7GQC sued by neighbors and served injunction to cease installation.
12-15-70	County Superior Court ruled injunction invalid. Case back to Board of Adjustment.
12-22-70	Neighbors filed appeal to City Board of Adjustment.
1-4-71	Board of Adjustment ruled City Building Inspector was to revoke building permit.
1-26-71	WA7GQC filed suit against City of Everett and neighbors.
4-30-71	County Superior Court ruled against WA7GQC. There is no Washington State law or Washington State court ruling to guide Washington courts on ham towers. Court ruled Board of Adjustment could interpret zoning ordinance and apply it as they see fit.
5-14-71	At appeal hearing court again ruled against WA7GQC.
6-10-71	WA7GQC filed notice of appeal to Washington State courts.

NOW, WA7GQC is determined to fight this through the Washington State Court of Appeals to get a legal ruling on the rights of ham radio stations to fully apply their hobby on their own residential property without restrictions by arbitrary zoning regulations. A favorable ruling would solve the similar problem of many hams in the state. Although WA7GQC has been able to carry the full burden of all attorney and filing fees to date, costs at the state level will really start to pinch the savings (in fact, the costs are out of sight!). So . . . hams, you are invited to contribute whatever you can. Make checks payable to "WA7GQC Legal Fund" and mail to

Hams Amateur Mobile
Service Club, Inc.
c/o Dwayne Lewis K7KSZ
2026 92nd Ave. East
Everett, Wash. 98201

Fund withdrawals require two signatures, that of the H.A.M.S. Club President and of WA7GQC. Any surplus funds existing when legal actions are complete will be given to the National Cancer Institute for use on cancer research.

Editorial Comment:

One of the basic purposes of the old Institute of Amateur Radio was to provide funds to help hams and clubs fighting court battles which could help all amateurs. No other organization (including ARRL) provides funds for this purpose, and the fighting of such court battles is left entirely up to the individual amateurs, no matter how important the legal precedent involved. Amateurs must accept that the fighting of these cases falls upon their individual shoulders and that they cannot just shrug and expect the ARRL or any other group to pay the freight. Please do send a $5 bill to K7KSZ and help this good fight.

Worlds RTTY Contest Winners

The British Amateur Radio Teleprinter Group (BARTG) was responsible for the scoring and handling of the "Worlds Championship of RTTY" for the past year. They have announced the winner as Giovani Guidette, I1KG.

Giovani was the winner of the "Worlds DX Contest," determined by the best scores in all the RTTY contests held in the past year. He is also among the leaders in the DX Honor roll and has assisted in many DXpeditions offering new countries for RTTY. For an oustanding signal and operating excellence we congratulate Giovani on his accomplishments.

The top ten finishers are listed below, and it is interesting to note that only 3 of the first 10 are from the States. RTTY has really become an international mode of communication.

1. I1KG – 120
2. VK2FZ – 80
3. I1CGE – 73
4. I1CAQ – 69
5. WA2YVK – 64
6. W4YG – 60
7. VE7UBC – 59
8. VK3DM – 55
9. VE2LO/W6 – 44
10. FO8BS – 41

HOT GEAR!

Hallicrafters SR46A #446100, contact WA1EMU, L. E. Fitzroy, Box 219, Hinsdale MA 01235.

EDITORIAL BY WAYNE GREEN

Eleven Years!

The first issue of 73 was dated October 1960, making this our twelfth October issue. Little did I expect, back in July 1951 when I mimeographed the first one-page RTTY Bulletin, that it would lead to all this.

Major Format Change for 73

While visiting Henry Radio a few weeks ago I got to talking with Cy Kahn (W6PXH), the Sales Manager, and he suggested that we include a page in 73 now and then which might be removed and used to build a handbook. Many of the foreign amateur magazines do this, so the idea was not difficult to consider.

As I thought over the idea, I wondered why we should stop at just having an occasional handbook page. After all, most of the articles in 73 are essentially just a part of an ongoing handbook. One of the best possible reference shelves you can have is a complete file of back issues of 73.

Why not, reasoned I, plan to make *all* of the articles in 73 so they can be made into a handbook? If we were to plan it that way we could be sure to start all articles on a right hand page and end them on a left hand page, making it so any interested reader could take the magazine apart later on and put all of the FM articles together, all of the logic articles together, etc. And, since no one article would ever be on the back of another, there would be no decision to be made as to which one was most worth saving.

To carry this on a bit further – why not include some pages of reference data to make the resulting handbook even more valuable? And how about publishing all of the circuits that can be gleaned from other sources? We could end up with a very valuable reference book!

Cy, I certainly want to thank you for suggesting the basic of a fine idea. I hope you will be proud of what your meddling has brought about. Now we'll get to work and see what we can do to make 73 into a truly great handbook. If you have any suggestions, please let me know.

All you writers and prospective writers should keep in mind that we will be more interested in state of the art articles than ever – in IC applications, logic use in amateur radio, phased lock loop applications, etc.

C. T. POWER

During my recent visit to Los Angeles I talked with K6RAD, Tom Litty, through the PARC repeater and then met him later at a PARC club meeting. Tom, the president of C. T. Power, invited me to stop by and see his operation in Hawthorne where they are making the 2m power amplifiers for FM which Henry Radio is selling under the Tempo brand name.

Bright and early the next morning (well, fairly early) I headed for Hawthorne and was talked in by Tom through the repeater and then direct on 76. The two meter power amplifiers were impressive enough, with models running up to 100W output! The real mind-boggler was a tiny 220 MHz transceiver which they had in prototype and which they planned on being able to sell through the distributors for under $180. With a rig like that available, it should be no time at all before we start seeing 220 repeaters springing up all around the country. This makes 220 inexpensive and practical.

One of the biggest drawbacks to the development of the 220 band has been the virtual absence of surplus equipment, either military or commercial, to get things started. Without all those thousands of surplus G.E. and Motorola FM units available at a fraction of their cost new, two meter FM could never have gotten started. Something like this 220 transceiver could easily be the spark that will trigger a 220 explosion.

Gene Smith (WA6MJD) on left and Tom Litty (K6RAD), the president of C. T. Power, examine a printed circuit board for their 100W 2m amplifier.

WANTED – CIRCUITS

In line with our plan for presenting 73 as a mammoth handbook, we would like to be sure to publish as many circuits as possible that would be of interest to amateurs. In many cases little explanation is really needed to make a circuit of value for the experimenter or technician. If you happen to run across a circuit which you think would be of interest to other amateurs, please send it to us. This can be a circuit you've worked out yourself, from an applications note of a manufacturer, or from one of the non-amateur magazines. If it is from another magazine, please let us know the issue and publisher so we can get copyright clearance before publication.

Make sure that all of the circuit values are indicated on the schematic and that any special parts are identified. In cases where there are tuned circuits we would appreciate getting data for the ham bands. Keep in mind that 73 is now read in over 200 countries and be sure that parts values are given, rather than just a manufacturer's number. A reader in Japan may not have a good source of B&W coil stock!

ATV REPEATERS

The one factor that has probably done the most to crush amateur television activity has been the little problem of the limited range of the 420 MHz band. Few ATVers have been fortunate enough to live within a stone's throw of another such afflicted individual, with the result that few have ever been able to do more than send pictures to themselves. That may be fun for a few days, but it gets old fast, and the dust gathers on all that equipment.

Getting on television is difficult enough without adding the formidable job of also having to put out a substantial 420 MHz signal, a job that has been hard enough to limit the occupancy of that band to a tiny handful clustered in a few population centers, if we overlook the FM repeater link stations which are usually point-to-point and for control purposes rather than communications.

Now suppose some of the repeater groups started putting in television repeaters! If it were possible to cover the wide areas on ATV that we can with low powered FM equipment, I would be very surprised if ATV didn't start blooming rapidly. Imported cameras are quite inexpensive, and I think that most UHF converters can be coaxed to tune down to our band, so little more would be needed than a small transmitter and a simple interface unit.

Quite a few of the repeater groups are adding a separate RTTY repeater

to their service. Most of these are set up, I believe, to repeat on 146.70 MHz. It would be nice if a few amateurs were to provide a repeater function from this channel down to 20 or 80m. Is anyone doing that yet? Why not?

TIMERS ON REPEATERS

As a converted low band ragchewer, one of my big problems in adapting to the 2m FM scene has been learning to shut up and listen instead of talking all the time. It has taken me quite a while to get used to the idea that repeaters are not to be used at all, only to be there so you *can* use them. If everyone is properly silent it is possible to have hundreds of stations all on one repeater without any interference.

The kick of the whole deal is in being able to communicate if you want to, not in the communicating itself. I haven't yet become hardened in this attitude, but I have visited some old-time FM operators who are able to sit and listen to a newcomer pleading over and over for someone to come back to him through the repeater. They totally ignore this greenhorn who doesn't know any better.

In some areas of the country I have noticed that older ragchewers like myself have ventured down to the repeater world and have set up shop as usual with their long-winded monotribes. I have noticed this when flying over their area, hoping to break in during the split second they stand by for the other half of the affair. Often I am able to pass through the entire repeater area during one hot-air blast and never have a chance to even try and break. Even in the car it is sometimes difficult to get a word in edgewise. I've been able to drive through the whole 100-mile coverage of a couple of repeaters without once being able to break a two-way exchange of trivia.

In Los Angeles I ran across a little device which foils these verbal dinosaurs. It is a timer which shuts down the repeater if the input carrier is not dropped for two minutes straight. Some repeater groups levy a fine on the offending op, others just hoot at him. The effect is that long-winded ops don't have a chance to develop their pernicious habit. And the two or three seconds for the repeater carrier to drop out that must be observed every two minutes at the least, gives adequate time for anyone to call in and join the fun, even if he is flying through.

Please understand that I am just as bad as the worst of these bores and boors. Given the opportunity, I am able to sound off for an hour straight, driving my audience – held captive more by the restraints of politeness than interest in what I may be saying – back down to the low bands. The two or three minute timer is one of the best things to come along to curb me and my kind. Let's seriously consider putting these fiendish devices on all repeaters. Okay?

A VISIT TO STANDARD COMMUNICATIONS

The simple front of the Standard Communications building in Wilmington, California, gives little hint to the bustling activity inside. Stan Reubenstein, the General Manager, took me on a tour of the plant during my recent visit to the West Coast. Frankly, I was quite impressed.

One of the big problems with imported equipment is getting it serviced. Every now and then I remember the Alan Sherman lyric, which ends . . . "If unsatisfactory you should bring it to the factory, but the factory's in Japan so rots of ruck." Standard has brought a lump of the factory service department over here, and they are alive and well in the smogs of lower Los Angeles.

Stan Reubenstein, the General Manager, pulls crystal pairs from the large stock kept on hand. How would you like to be let loose near those drawers full of ham band crystals for about five minutes?

JH1QBV takes time from servicing some 826 modules to look at a Polaroid picture of him servicing 826 modules. Almost all of the service department are Japanese amateurs. Now if we only had reciprocal licensing with Japan they could get on the air through the repeaters.

JH1SCC checks out a new 826 before shipment to make sure the output is up to snuff and that everything is working satisfactorily.

It didn't take very long for Stan to convince me that I should install a Standard 826 in my rented Pinto, complete with crystals for the local repeaters. They have a little plug that goes into the cigarette lighter for power, and I borrowed a magnetic quarter-wave antenna which we put in the middle of the car roof, running the coax in the door to the rig on the seat beside me. It worked fabulously, and I found myself instantly in touch with hundreds of FMers. That rig sure made my visit out there a lot more enjoyable, and you may be sure that I will have it along with me whenever I make any trips.

JA1RVW checks out a new module in an 826. Standard keeps a complete stock of the modules on hand to simplify repairs. It is faster and less expensive to change modules and let the factory service the modules.

Standard, by the way, has just leased a huge building next door to their present building and they are expanding into it. The sales of 826's for amateur and marine use calls for quite a bit of storage area, plus they are setting up a crystal-making facility to help them keep up with the crystal orders. They carry one of the largest amateur frequency crystal stocks that I've ever seen and have just about any pair on hand for immediate delivery.

W2NSD continued

A VISIT TO MANN

All that FM equipment! Hundreds, or is it thousands of FM sets! At the time I visited they had some of those Kaar 120W 2m units right out there where I could eat my heart out. I think that I might manage to get into every repeater in the East with something like that. Of course I wonder what it would do to my car battery. I suspect that it might draw so much current that it would suck the battery right out of its moorings and send *it* through the local repeater.

NEWSPAGE TYPE ENLARGED 12%!

As an experiment we are trying the newspages this month set up vertically with the type 12% larger than in previous months. Of course this means we can't get quite as much material in the pages, but they should be a bit easier to read.

Want to really understand the Mid-East situation?

The *only* clear and concise explanation of the muddled mess in the Mid-East is in the book *"Search For Peace in the Middle East"*, written by the Quakers (AFSC). We have a few of these fascinating books left – first-come, first-served – 75¢ ppd. Radio Bookshop, Peterborough NH 03458.

The DX has never been better, so come on down from that 2m FM now and then and grab a rare one. Gus reports some juicy stuff for those that take the time out from jawing to listen – such as AC5PN on 14020–40 around 1330z (If you are one of the few that need Bhutan, W6DDM/KB6 on Canton Island has a whale of a signal on sideband (14285), QSL to Box F160, APO SF 96401. Look for Joe around 0800z. K4CSY/KC4 seems to have activated Navassa again and says QSL to KG4CS or the K4 bureau. Lettuce see about FO8BQ on Tuamoto Island (14023 @ 0130z, QSL to WA6MWG. You probably have EA9EJ in Spanish Sahara, right? No? Well, listen for Justo around 14220 @ 0630z. CR8AG in Portuguese Timor is almost as rare as they come. Look for his listers (like CT2AK) and get set to make a quickie while Adriano's gas generator has fuel. The action is around 14210 @ 1000z and QSL's go to PY7VS, Box 74, Fortaleza, Ceara, Brazil. Should we mention to include 2 IRC's and SASE? We hope not! You've probably all worked a Sao Tome station by now, so if you need a second contact you'll be on the watch for CR5AJ around 14000–13 @ 2100z. QSL Box 68, Sao Tome. M1I is still active, heard recently on 14200 @ 2245z, QSL 11BNZ. Jordan is hopping with hams these days, sorta – JY6RS on 21013 at 2235, QSL Box 2353 Amman! Don't forget the Southeast Asia net on 14320 daily at 1200z for run-of-the-mill Asian DX such as VS6, 9N1, HS, and plenty etc. Want 5X5NA? Get on the W3ZNH list for Saturdays on 21355 before 1800z, QSL G3LQP

The president of the Maldives is 8Q6AA and should be on the air soon. Ask him for a picture for us, eh? The Brisith military will continue to use VQ9 calls. Yemen has been scarce lately, so you might need 4W1AF who has been reported around 21350 @ 1700z. YJ8BL New Hebrides on 14297 @ 2330z, QSL to W6NJU. 7Q7CY promises to be very active on all bands over the Oct. 30th weekend. Check 28550, 21360, 14280, 7090, and 3795 and QSL to K9BNF. VR6TC is on every Tuesday and Thursday on 21353 @ 233-z. George VR4CG comes on 14242 at 1200 and hates pileups, so be careful or you'll lose him. Thanks for all that adrenalizing news, Gus.

The West Coast DX Bulletin has this interesting letter from AC5PN to K6KA, a long-time 73 contributor:

Dear K6KA: Your friends in southeast Asia are very correct to have heard my call. I have very recently started to work on the amateur band. There was Mr. N. Chhawna previously working AC5PN, our ex-Chief Signal Officer of Bhutan. But the said gentleman is no more in Bhutan now. Since he left the country, no substitute dared to occupy his work immediately for want of proper knowledge which continued for the last 5–6 years. I am the newcomer in this line and very new. My name is T Yonten (full name is Thuji Yonten). Before I should regularize my work in amateur bands, I would like to enroll my name in the membership of Amateur Radio and would also like to change my callsign for which I have already written to ARRL. As soon as I get confirmation from them I shall immediately arrange to print my new QSL cards and at that time I shall forward a copy to you.

I shall be very much thankful to you if you please help in providing a regular membership in amateur radio and in changing my call sign as AC5PY instead of previous AC5PN. The technical description of my station . . . transmitter Bel Et 402, 400w a.m. 1.5–30 MHz. Receiver – Bel Ru 536 1.3–28 MHz. Dipole antenna 30 ft high favoring east/west.

I am a bonafide citizen of Bhutan.

T. Yonten
Director, Wireless Communications
D/Tshe, Thimphu, Bhutan

* * *

The situation in Ceylon is still tense, and amateurs there are hoping that their transmitters will be returned soon, but not expecting much in the

VISITING PARC

Recently, while in California, I had an opportunity to pay a visit to the Pallisades Amateur Radio Club in Culver City. They had a very interesting program and a standing-room only crowd of friendly members. Coffee and doughnuts after, plus lots of eyeball contacts. The club, with over 200 members, keeps alive by accentuating a broad approach to amateur radio. They have their own repeater for the FM group (WB6ZDI) and it is probably the most active repeater in the Los Angeles area. They have plenty of DX'ers, ragchewers, Novices, builders, and representatives of every other interest that makes up our hobby. . . .W2NSD/1

way of permission to operate for a while. The Burma amateurs have been greatly encouraged by the return of their transmitters and the re-issuance of their licenses. Perhaps they will get a go-ahead one of these days and precipitate some monumental pileups.

* * *

The RTTY DXers have been very busy pecking at each other. You might hook up a printer and check the high end of 20 CW (14090) and see for yourself. A recent night's play for the more nimble fingered included PZ5RK, EA8CI, CP5AD, 9J2ED, VP7NH, 9Q5BG, 4Z4MR, 9Y4VU, KX6IT, JA1FFX and FO8BO. Not bad for one night! Keep in mind that FG7XT has 110 worked (102 confirmed), with ON4BX at 108 worked, 11KG at 104 and W3KV at a miniscule 103.

From the DX Mailbag:

On November 6th and 7th, the Sunshine Coast International Rodeo will be held at Nambour, Queensland.

Our club has decided to take advantage of this and for the duration of the Rodeo will be operating the club station, VK4SZ, from the grounds. Frequencies will be 14275 and 14175 kHz, and times of operation will be from 1800 to 0700z each day, but these could be altered to suit prevailing conditions. We are having special cards printed, and QSL will be 100%.

P. Cox
SCAR Club
3 Bambaroo Ave.,
Nambour 4560 Australia

As your newest subscriber and keeping faith with your instructions to "Keep your ears clean and listen for news . . . " I am sending you the following QSL address information for some special calls that I logged.

VB1MSA via P.O. Box 1462, St. Johns, Newfoundland, Canada or the VO1 bureau. (Call issued to commemorate Marconi's Seventieth Anniversary.)

VA2UN via W2GHK (Call issued to commemorate the 100th anniversary of McGill University.)

WF7AIR via K7ABV (Call issued for the Montana State Fair.)

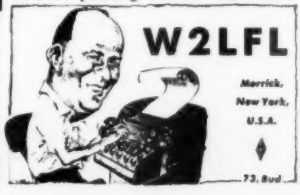
R. Stephen Dildine, Jr.
1900 S. Eads St., Apt. 725
Arlington VA 22202

I went up to the International Field Day held near Charlotte, Vermont, and I had a ball. However, I suffered a very severe case of shock when I actually met *two* Vermont Novices. In eight years as a ham and even after a year in neighboring New Hampshire, I was still firmly convinced that Vermont simply did not exist on the Novice bands. Of course, I still *know* that there is no such thing as a Wyoming Novice . . .

Jim Askew, WNØDRO, of Mitchell, South Dakota is willing to give anybody a hand who still doubts that all 50 states are represented on the Novice bands. You can drop Jim a card at 604 North Rowley, Mitchell, S.D. 57301 to arrange a sked. I sure hope Jim has a large mailbox.

If you still have not gotten a copy of *The Novice* you'd better send your SASE to Greg Ginn at 1240 21st St., Hermosa Beach, Calif. 90254. The last two issues have posed some pretty probing questions about ARRL opposition to a 10m Novice band. The sooner a Novice can get into ham politics, the sooner he can start working for the preservation of his hobby.

After a few months on the bands, I'm sure that we all must have a shoebox full of the WRL and W50WC QSLs. Although they are very fine quality cards and they are sold at really reasonable rates, I'm sure that many of us would like to see something different in the line of Novice QSLs. Custom designs and photo cards are nice, but they can cost a lot. If a group of guys in one town can work out a common design with just the call and QTH changing, you can sometimes have them printed reasonably. Printing is a very competitive business. With some shopping around you can often get a good price. My high school radio club worked out a club design and some club members taking graphic arts printed them for everyone on the school's shop press. An easy way to cut costs is to arrive on a simple black and white card without printing on the back. This will take only one press run. One of the most distinctive types of simple cards is the caricature card – either humorously done like that in the W2NSD card or more accurately done as in the W2LFL QSL. With some thought and planning, a caricature, your call, the report, and your QTH can appear on one side of the card. Of course it helps to know a friendly artist who would like the instant notoriety resulting from designing a ham QSL!



The QSL from W2LFL was picked up on a recent visit to Bud. A particularly eye-catching feature of Bud's shack was a display of foreign postage stamps – all from the envelopes containing DX QSLs he has received. Although no Novice DXer is in the 200 country range of Bud, it doesn't take very long to acquire 20 or 30 foreign envelopes. Simply arrange the envelopes attractively, glue them down to a piece of carboard (rubber cement works best as it allows you to make changes easily) and make some sort of frame – cardboard, construction paper, or even wood.

Bud also has quite a few hints for Novices (or anybody else, really). Bud keeps meticulous records of his ham activities. Ask about his antennas, and he will pull out charts of SWR vs frequency that he drew himself with dime-store graph paper and his regular SWR bridge. Ask about his CW monitor, and he has the schematic in a loose-leaf binder. While record keeping might seem like a waste of time now, whenever Bud wants to modify a piece of gear he designed or whenever he wants to make changes and improvements in his shack, he has a guide; he has an ongoing record.

Lest one call Bud a fanatic though, Bill (K1CLL), our perennial VHF experimenter, keeps a notebook of *all* his experimental projects. Of course Bill doesn't slave over it. A few sketches, a quick schematic, and a note about a weird junkbox part doesn't seem to slow Bill down, but they sure make troubling-shooting, improving, and duplicating a rig a lot easier. A startling example of Bill's note-taking was a recent antenna building project of ours. I mentioned that I wanted to build a good 20m beam. Bill brought over his notebooks from the 1940's and in them were all the dimensions on lengths and spacing that Bill had worked out over months of experimenting in his commercial antenna test lab. It really saved me a lot of trouble.

So, if you start now to keep all your owners' manuals together and your sketches and ideas, you'll find that you are quickly developing a personally tailored reference library of your own experimentation. .WA1KWJ

TAKE NOTE

I have a few comments to make about my fellow hams. I know that you've probably heard every word, printable or not, that has ever been said about operators and what they call their "operating technique." Well, bear with me because I have a few that obviously need to be rehashed.

About a week ago, I started listening around twenty. I blew my balanced modulator tube and couldn't find a replacement. I was really surprised to see what people like myself sounded like. Now let me get one thing straight from the start. I'm not setting myself up as a prima donna. I guess most of the things I have to say have applied to me at one time or another. Anyhow, I'm trying to cure my problems.

I heard people deliberately interfering with nets, phone patches, and each other. A couple of my friends and I were on one of the mobile nets. The whole time we were on (about 2 hours) there was some "person" tuning up. I use one of the popular transceivers with sweep tube finals. I wish my finals could take a beating like that. Maybe they could use that as an ad for one of the linear manufacturers.

There are other dragons to slay. Where have I heard that phrase before? I have an actual example. I was on 20 at 1600 GMT on July 27, 1971. I called "Is the frequency in use?" three times. So I called CQ and W3MSD comes back, and we started chewing the rag. Well, within five minutes we had three people tuning up and two QSO's trying to talk over us. Sound like your last QSO?

I'm sure that anybody can think of at least one QSO that ended like that. Then we have DXpeditions and certificate stations. Now I love DX as much as the next man, and like everyone else, I never seem to work enough of it. But there is still no excuse for intentional interference and lousy "operating technique."

I think I'll pick on WB4ICJ for this one. Right after the Apollo 15 launch, there they were, handing out contacts in an orderly and speedy manner. That lasted about 3/4 of a minute. Then the big guns came in and tried to break through the system of working five in a call area and then going on to the next one. The crew down there stuck to the system, and for the first time I've actually seen only people in the proper call area say something. My congratulations to the operators down there.

Finally, a word about people who were there first. W4WDT was in QSO with another station about 1 kHz up from WB4ICJ. When he started the QSO, he was the only one on and couldn't have heard WB4ICJ. The point is that W4WDT had the right of prior claim. But WB4ICJ had announced that the frequency would be on at a certain time and place. So who has the rights? Some "well meaning" soul started calling him names. I went down and he politely agreed to QSY, WHEN HE WAS ASKED POLITELY. The moral of this little tale is quite plain and quite old. "You can get more flies with honey than vinegar." My thanks to W4WDT for QSY'ing and my apologies for my inconsiderate fellow hams.

This can all be summed up in one phrase – "Treat your fellow hams like human beings, and you'll find they'll treat you the same way." If you print this letter, put my name and call in LARGE TYPE. I'm a ham and proud of it. I have a call and always use it. If I've mentioned something that someone recognizes as himself, then change your ways. And if I've stepped on some toes, I'm on twenty from 1530 GMT until the band closes. I know I'll hear somebody QRM'ing me. So answer my CQ and tell me how I trod on your foot, instead of just trying to talk over me. Even if you do drown me out, wouldn't you rather let me talk than have to read another one of these letters?

BOB SHAW WB9FIN
333 Blackfoot Court
Fort Wayne IN 46805

N.C. Ham Plates

It has finally happened! We have been classified with the Class D CB crowd, at least in North Carolina.

The North Carolina legislature in its wisdom(?) decided that the hams were getting off too easily at only a buck extra for call letter plates.(NC cars only get one, so it is plate, singular.) The fee was raised from $1 to $5 per year. Well, that's not too bad – inflation gets everyone. However, our ever-wise state legislature decided that the CBers were entitled to call letter tags at this same rate.

Damned if I want to be placed in the same category with the largest problem the FCC has – Class D CB! Even only on tags. Newspapers already refer to "amateur radio" when they mean CB. How many people will know the difference between a "KKK-1234" tag and a "W1XXX?"

Damn it!!!

For once, here is an issue that all NC hams can get together on. The ham vote is substantial – let's use it to good ends!

F. C. Hervey K4ETZ
Rt 1, Indian Trail NC 28079

REPEATERS

I have read with interest the many articles featured in your magazine and several times the excellent Repeater Handbook by K6MVH. At this time I have several comments and questions on diverse subjects. First, for your information since November 1970 we have here in Fredericton an AM repeater VE1PD operational on 147.800 input and 144.225 output. It gives good coverage to Central and Western New Brunswick and Eastern Maine. It might be something for the DX hounds to look for on inversions, as I expect not many think to look in this direction on such occasions.

The licensee is Claud Bailey, VE1HU. The repeater is located at an elevation of 1325 ft on Crabbe Mountain, 35 miles north of Fredericton with a 5.8 lb. collinear antenna on top of a 300 ft tower, duplexer, and runs a 50 watt base station connected for repeater service. It provides what I believe you refer to as superrange service, having very low desensitization, reasonable power and high antenna gain.

Now we are faced with the same question as proposed in the July "FM Scene," i.e., with 46/94 in St. John, N.B., 75 miles south and in Moncton, N.B. 120 miles east and 34/94 in Charlottetown, P.E.I., 250 miles east, what should we use for frequencies on a local coverage FM repeater, which we hope to have operational by November 1971. I'm partial to 34/94 myself to eliminate overlap entirely, but any advice or other confusion will be greatly accepted.

Frank Ryder VE1AHL

RE: ELECTRONIC HEALTH

As I, together with Wayne Green, have been charged with being potential murderers, I believe I have a right to reply in the same column used by Mr. Shafiroff and also feel it is my duty to other readers of 73 to clarify the situation. My grandfather and the majority of his 12 children, including my father, died of cancer, and my sister had a breast cancer removed, so I have had good reason to become well-informed on the subject.

First, I would point out that the charge of quackery is made with no consideration of the stature of the scientist, Lakhovsky, nor of the opinions given in the books referred to, by qualified medical doctors who used the oscillator in their practice. I do not doubt the sincere intent of Mr. Shafiroff any more than I doubt that he has been brainwashed. On the basis that the simplest effective remedy is

the best, I would much prefer the use of the Lakhovsky oscillator to the remedies he mentions for skin cancer. To condemn without investigation is the surest way to maintain ignorance. A quack is anyone who is more interested in income than genuine aid to others.

I would urge anyone interested in ethics and cancer to read *A Matter of Life or Death"* by Herbert Bailey, and then decide who the murderers are. This book is thoroughly documented, available in paperback by McFadden-Bartell at 60¢. If that is not enough to turn your stomach, try *"Cancer Facts and Fallacies"* by Rodale Press, *"A Cancer Therapy"* (with 50 case histories) by Dr. Gerson, or of the experiences of Dr. Nolfi, Dr. Frost, Dr. Koch, Dr. Wilson and Mucorhicin, of Dr. Lincoln, Hoxey or a dozen others who developed promising cancer therapies only to be ignored or persecuted. Courts agreed that Hoxey cured cancers, but he was put out of business. Prominent Sen. Paul H. Douglas was unable to force our federal government cancer agency to give Krebiozen an honest test. Read the Fitzgerald report to Congress before charging quackery.

Or read the National Health Federation bulletins, Prevention or Let's Live magazines, Health Research publications, or write the Association of Cancer Victims and Friends, 5525 El Cajon Blvd., San Diego, Cal. 92115, and find out who helped them when hope grew dim and purses slim.

When Columbus crossed the Atlantic the American Indians may have had more effective medication for cancer than the AMA has approved up to now. Creosote bush tea, anyone? A real cure can only come about by Nature when intelligently assisted by man. The latter must furnish the tools and Nature does the work. Cancer may be removed by surgery, but technically I do not consider that a cure. Of course I do not oppose surgery under favorable circumstances. I doubt if President Nixon has the power to force the appropriate government agency to test the various cancer remedies of promise and give an honest evaluation of them.

Charles A. Moore
Av. 27 Poniente 2520
Puebla, Pue., Mexico

Silent Key

Perhaps you remember Rose and Ben Hurevitz who went to Europe with you and the 73 gang in 1963. We last saw you in 1968 at the Long Island hamfest. Ben died of leukemia in May 1969, in case some of the many hams that contacted him during his last nine months – much of which was spent on the air – may have wondered at not hearing WA2NWJ recently. If you ever make another group trip, please let me know as I would like to join the group.

Rose Hurevitz
Bellerose NY

PRODUCT REVIEWS

Dear OM,

Why not review the Yaesu FT-101 and/or its companion linear? You hear them all the time!

Guy Blencoe W4HVU

Excellent idea. Perhaps a reader will oblige? I do hear them a lot and would be delighted to get a review. I'm sure that you don't want a review from me for I always say nice things about products advertised in 73 (I know which side the bread is buttered on). Come to think of it, the Yaesu hasn't been advertised in 73. Perhaps a nice review would change that? Note: Lest you think that the dollars cloud my vision, you don't find reviews of bad gear published in 73. If it's good we'll tell you about it. If it's bad we will pretend it doesn't exist. I would much prefer to be able to say bad things, and it would take several pages of examples to prove why I eventually learned (the hard way) to shut up about lousy gear and hope that it just goes away instead of making a big deal about it.

. . . Wayne

BETTER BUSINESS?

I received my Novice license on May 3rd of this year, and I am extremely proud of it. Being an active Novice I purchased a summer edition of the Radio Amateurs Callbook. I have also ordered the supplement which is supposed to arrive on September 1st. In the meantime I have worked quite a few Novices who are not in the Callbook, and I didn't get their complete QTH or I wasn't sure of it, so I wrote to the Federal Communications Commision about 6 or 7 times to find out these Novices' QTH's. They answered me very nicely for the first four times, then they started putting up a fight about answering. Well, I got the seventh letter back today and they didn't even bother to answer my request. Now I wonder, with over 290,000 amateurs who pay $9 every five years for their licenses, why we can't get any better service out of the federal government than this.

Tom Lenzmeier WNØEPO
679-47½ Ave. NE
Columbia Heights MN 55421

If they aren't going to give service they should send your $9 back.

. . . Wayne.

HELP

Last week I received a letter from Roland L. Guard K4EPI. He wrote that he can sponsor me when he finds a good job. He is a good friend of mine and my first QSL manager.

I am now working here in Istanbul. Still, I am always trying to do something to continue my education. I have received only one letter from Tri-State College, Angola, Indiana. The have W9BF Amateur Radio Club and they sent an application with an abridged catalog listing the various programs offered at the Tri-State College.

I must leave Turkey before November, 1971. If not, I'll be a soldier. That's the end of my education. After two years of military service I can't continue my education. I hope there is an American family who can sponsor me. As soon as possible I must find a way before November. This is the situation from my side.

Every month I receive 73 magazine, so I'm very happy to read the latest news and to learn many things from 73. Thank you very much.

Is there any good news from Washington Radio Club for me? May I find a job in the USA during my education? I only hope you and K4EPI Roland L. Guard can do something for me.

My address is:

Selim Canbeken
Kadiraga Sok. 15 Da. 8
Goztepe, Istanbul, Turkey

Isn't there one family in the whole country who can sponsor Selim so he can come to the U.S.? Selim is a very bright young lad in Turkey (TA3SC) and has even managed to build his own slow-scan receiver before having his equipment confiscated by the government (amateur activity is not permitted in Turkey). He wants to come to the U.S. desperately, but cannot come until someone agrees to sponsor him. There must be a ham somewhere out there who can help this lad.

. . . Wayne

HA!

There are too many flaws in WN4ONW's article, "DX From The Stars" (Aug. 71) to make it worth commenting on.

How ridiculous, a Novice with an all-band mobile fone rig – one with all bands active late nighttime in October, too!

Ron should have written the "Enquirer."

Ha!

Ed Howell W4SOD
Folly Beach SC 29439

Perhaps Ron was giving a subtle hint that this was fictitious?

. . . Wayne

LETTERS

Continued from page 11

When the tone returns

The announcement that WWV will no longer use code in transmitting its data again revives the question of why the FCC puts so much stress on code copying ability in its ham licensing.

Nearly all time and frequency standard stations now use voice announcements instead of code. Maybe the change of format by WWV will influence the FCC to join the 20th century, too.

Ernest T. Robarge
Sendestation
684 Lampertheim/Hessen
Wildbahn, Germany

OK EXCHANGE

I teach electrical/electronic/radio and TV mathematics subjects at various levels at County Technical College, Norfolk, England, and I am seeking a one-year teacher exchange with aAmerican teacher. I have been selected on this side, but so far we have been unable to find an American teacher (and family) desirous of working and living in England (but retaining U.S. salary) for a year from August 1972.

If any of your teacher readers (perhaps, but not necessarily, a ham) would be interested in an inexpensive one year "holiday" in England, I invite them to write to me or contact my "exchange manager" WB2FBF who would answer any local query. Official details and application forms in the U.S. are obtainable from the Office of Education, Washington, DC 20202.

Thank you for letting me use your correspondence column for an appeal.

David Lake G3ZCA
County Technical College
Tennyson Ave., King's Lynn
Norfolk, England

HELP

By reading several of your FM articles the past few months I got interested in 2 meters. I'm one of those that never got above 10, and that was about 10 years ago on AM.

I need some help. I picked up a fine VHF base station complete with a coupling shelf for tying to a phone line, etc. It has a decal as being build by Secode in San Francisco. Thanks to International Crystal, they furnished me a couple of crystals to get it on the air. I would like to find someone who could furnish me a schematic on the receiver and possibly the transmitter. The number printed on the receiver is "648-RMR" and transmitter is "649-RMT."

Meanwhile, keep up the good magazine. I enjoy 73 very much and find most articles interesting.

Leon Brandon K5OKZ
8602 Lazy Acre Cre.
Dallas TX 75240

YES, SIR!

I noticed that the July cover of 73 did not show a Texas radio operator's license plate. On the chance that your barn is going without such an *essential* thing as a TEXAS plate, I hereby present you with mine. Show it with pride! Take good care of it . . . I only get two of these QSL cards a year!

Jim Greenwood WA5RCF
2800 Stratford Dr.
Austin TX 78746

Mobile Hint

At different times I have installed mobile units in my cars and have the problem of finding a suitable source of power to operate the unit, so I came up with the following way to do it. Use a length of RG8U, cut it back about 4–5 in., and secure the outside braid to ground and the center conductor to the battery side of the starter relay. Next, drill a ½ in. hole in the fire wall and bring the cable through it. Terminate the coax with an Amphenol SO #239A. On the power leads from the unit, install a PL259. Be sure to get the positive lead to the center of the PL259.

I had no engine noise to bother reception. An in-line filter can be inserted by using two PL259 and two SO239A.

Herb Baumchen WAØWGA
Salina Star Route
Boulder CO 80302

DXpeditions

The Squaw Island DXpedition was one of the finest articles I have seen in 73 for some time. It shows the fellows not only had a lot of fun, but that there is a certain ludicrousness in the "Big DXers" that are sometimes heard.

Sometime I'd like to take a ship of foreign registry, where R&Rs are not too strictly observed, and, within the international waters operate as 5Y3GT (the popular rectifier tube). The weaker the signal the better.

K1YSD's letter duplicates my feelings. It is fine to be a specialist magazine, but that sort of drops out the generalists. I think 73 is at its best when the genius himself is in control. Hope you'll stay at your desk.

Paul Schuett WA6CPP

I would like to draw the attention of the W/VE hams in particular and all hams of the world in general that the statement made in the QST of May 1971 on page 101/102 regarding the VU5KV expedition is not true. Both the VU5KV and the VU9KV expeditions were organized by me and were financed by me and had nothing to do with the Amateur Radio Society of India. This society had arranged only the VU7US expedition mentioned in the QST item. I would like it therefore to be known to all that the ARSI has nothing to do with my expeditions.

It would be wrong for me to comment on the ARSI expedition, as firstly it would not be in good taste, and secondly I cannot say anything about it of my own knowledge. I was busy myself during the entire time keeping the VU9KV station on the air. However I have no doubt whatsoever that the entire ham fraternity would agree with me that the QST has done me an injustice by talking of the VU5KV and the VU7US expeditions in the same breath.

I hope you will publish this in the next issue of your magazine and let the ham fraternity known the correct position.

K Venkataramanan
VU2KV/VU5KV/VU9KV
102 Jorbagh
New Delhi 3, India

73 A PORNO MAG?

You'll probably find this hard to credit but every past copy of 73 has been held here by the customs. They must think it's a porno mag. A lot of my mail from USA and other places never arrives. A certain confrontation has arisen between us. I gave them a bit of a rub in 'ON THE SPOT' – I wish I could put the boot into them properly. Unfortunately we've got a dim and stupid lot in this city. It's not an old gag line – but a mate of mine went to pick up a cake (it had, like my 73, to be opened in their presence). He arrived a little too early – they were eating it for afternoon tea. No doubt my mags are taken home by somebody and read for the pleasure. Sorry to gripe you with this

I must take this opportunity to thank you again, Wayne, for running my short stories. Seems to me they are enjoyed, and I think any technical magazine is made a little more interesting and human by the addition of a little satire or send-up – even if it is a little corny and close to slapstick at times hi. If I can get a laugh I'll send myself up with the greatest of will. Funny how the public never tires of this, and AR is no exception of course.

Recently had a compatriot of yours here in the shack – a journalist – telling me the Americans don't laugh at themselves as well as the English do. Don't know about this, but Phyllis Diller always does a good job on herself hi.

Al Shawsmith VK4SS
35 Whynot St.
West End, Brisbane Q. 4101
Australia

OKLAHOMA

The Annual Texoma Hamarama will be held again this year at Lake Texoma Lodge, Kingston, Oklahoma on October 29–31. Programs for both men and women are planned. There will be technical talks, demonstrations and special interest meetings. Bingo and special entertainment is planned for the ladies. This is a family affair. The annual area meeting of the QCWA has in the past brought oldtimers from surrounding states.

Reservations for accommodations should be sent directly to the Lake Texoma Lodge, Kingston, Oklahoma 73439. All pre-registrations are $2 and should be sent to Texoma Hamarana, P.O. Box 246, Kingston OK 73439, before October 25.

HAMFESTS

The Monroe County Radio Communications Assoc. will hold their second annual hamfest from 10 a.m. until 4 p.m. on October 10, 1971, at the Monroe County Fairgrounds in Monroe, Michigan. A full day is planned, including prize drawings, contests, and good food. Directions to the hamfest and advance registrations ($1) are available from the Monroe County Radio Communications Association, Box 486, Monroe MI 48161. There will be a talk-in on 146.94 MHz.

PENNSYLVANIA ERIE HAMFEST

The Radio Association of Erie will hold their annual hamfest on October 9, 1971 at 6 p.m. at Sara Coyne Restaurant, 44 Peninsula Road. There will be prizes, guest speakers, and awards. For more information and dinner reservations ($4.50), write to George Dickey K3VLP, at the RAE, Box 844, Erie PA 16512.

TEXAS SWAPFEST

The 17th Annual Brownfield Free Swapfest, sponsored by W5HPI, Terry County ARC, will be held in the National Guard Armory, Brownfield, Texas, on Oct. 24, 1971. There will be Army MARS and West Texas VHF Clubs meeting. Doors open 7 a.m. local time. Catered Dutch buffet lunch. Eyeball QSO's, refreshments and entertainment, evening of October 23rd for early arrivals. Door prizes. The public is welcome.

ARIZONA

WA5YUT	(Ft. Smith)	34/94

CONNECTICUT

WA1JTB	(Bridgeport)	31/88
WA1KGK	(Trumbull)	22/76
WA1KGD	(New Haven)	11/61
WA1INO	(Avon)	28/88
WA2SUR	(NYC)	19/73
WA1KGR	(Holyoke MA)	34/94
W1BNF	(New Britain)	37/97
WA2UZE	(Huntington NY)	52/76
WA1KGQ	(Vernon-Hartford)	25/79
(alt. 19/79, also 4443.3/448.3 & 52.76/52.525		
K1IIG	(now WA1INO)	
WA1DMX	(now WA1KGQ)	

FLORIDA

WB4KNQ	(Merritt Isl.)	34/70
(also 443.1/448.1)		

ILLINOIS

WB9HWS	(Hinsdale)	22/70
(higher powers can be toned on)		

INDIANA

W9INX	(Fort Wayne)	28/88

KANSAS

WAØSNP	(Topeka)	34/94
WAØCJQ	(Salina)	34/94
KØFRA	(KC MO, defunct)	
WAØOFH	(now WAØAMR, KC MO)	

MAINE

WA1KGP	(Sanford)	13/73
K1MNS	(Derry NH)	25/76

MASSACHUSETTS

WA1NJR	(Boston)	34/94
WA1NJR	(Boston)	31/91
(Also 31/52.525 & 52.525/91, Touchtone and 440.15/445.15		
WA1KGO	(Peterborough NH)	37/73
K1MNS	(Derry NH)	25/76
W1PRI	(Weston)	22/82
W1QFD	(Marlboro)	147.03/87
W1VAK	(Falmouth)	34/94
WA1KGR	(Holyoke)	34/94
WA1KRJ	(Worcester)	37/97
W1MTV	(Westfield)	10/70
WA1NEU	(Pelham)	22/76
WA1KGQ	(Vernon CT)	25/79
		19/79
WA1KFZ	(No. Adams)	04/91
K1ZAW	(Beverly)	28/88
W1ABI	(Killington VT)	28/88
WA1KFX	(Mt. Snow VT)	31/88
K1ABR	(Providence RI)	10/70
WA1INO	(Avon CT)	28/88
WA1KGM	(Mt. Ascutney VT)	16/76
WA1KGS	(Waltham)	01/64
(also 444.05/449.05)		
WA1KGL	(now K1ZAW)	
WA1KFY	(now W1PRI & W1QFD)	
K1ZJH	(now WA1KGR)	
W1AQJ	(now WA1KRJ)	

MICHIGAN

WA8BDD	(Clarkston) (was 34/76)	31/85
WB8CQS	(Detroit, GLRA)	34/76
K8VLN	(Detroit, DART)	46/64
WB8CQO	(Toledo OH)	34/76

MISSOURI

WAØVUN	(No. KC)	22/82
WØOKB	(Savannah)	10/94
WØOKB	(secondary)	34/94
WAØAMR	(KC)	34/94
KØOKI	(KC, 448.1/449.1)	
KØOKI	(KC, 52.88/52.525)	

NEW JERSEY

WA2UWC	(Greenbrook)	34/94
WA2UWO	(Fords)	28/76

NEW HAMPSHIRE

W1ALE	(Concord)	34/94
W1KOO	(Mt. Mansfield VT)	34/94
WA1KGP	(Sanford ME)	13/73
K1MNS	(Derry)	25/76
WA1KGO	(Peterborough)	37/73
WA1KGR	(Holyoke MA)	34/94
W1MTV	(Springfield MA)	10/70
WA1NEU	(Pelham MA)	22/76
WA1KGM	(Mt. Ascutney VT)	16/76
W1PRI	(Weston MA)	22/82
W1ABI	(Killington VT)	28/88
WA1KFX	(Mt. Snow VT)	31/88
WA1KFZ	(N Adams MA)	04/91
WA1NJR	(Boston MA)	34/94
WA1NJR	(Boston MA)	31/91

NEW MEXICO

?	(Albuquerque)	16/76
?	"	22/82
?	"	28/88
?	"	40/00

NEW YORK CITY

WA2SUR	(NYC)	19/73
WB2UWC	(Greenbrook NJ)	34/94
WA2YYQ	(Staten Island)	25/88
(RTTY)	(Staten Island)	25/70
W2CVT	(Mt. Beacon)	37/97

NORTH CAROLINA

W4PAR	(Lexington)	31/91
(on 0700–0100; 25 watts)		

OKLAHOMA

WA5SJE	(Tulsa)	22/82
(was WA5KWH, now carrier op)		

RHODE ISLAND

K1ABR	(Providence)	10/70
W1HQV	(Providence, alt)	10/70
K1OHE	(Bristol CT)	34/94
K1IGF	(Groton CT)	19/94
WA1KGQ	(Vernon CT)	25/79

SOUTH DAKOTA

?	(Brookings)	34/94
?	(Sioux Falls) (1800 Hz)	34/94

TEXAS

W5YNL	Plainview)	22/82
		22/94

VIRGINIA

WB4URR	(Blue Mt.)	37/97

Caveat Emptor?

Price — $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agencydiscount. Include your check with order.

Deadline for ads is the 1st of the month two months prior to publication. For example: January 1st is the deadline for the March issue which will be mailed on the 10th of February.

Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.

We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

For $1 extra we can maintain a reply box for you.

We cannot check into each advertiser, so Caveat Emptor. . .

COLLINS KWM-Z, 516FZ, W/NB, Waters Q-Multiplier $700.00, 62S1 $550.00, 30L1 $350.00, SP600 JX-17 $285.00. Bruce Bouvier, 2609 Finlaw Ave., Pennsauken NJ 08109, 609-662-6575.

WANTED: I. F. Plugin unit complete for Collins R391/URR. K1GVA, 61 Warwick, Portland, Maine 04102.

SELL: Heath SB-620 Scanalyzer, 455 kHz i.f. Perfect condition, $100. Sorry, cannot ship. Write: Don Parmentier, WA6CPM, 737 Golden Oak, Sunnyvale, CA 94086.

TAMPA HAMFEST – Electrical Building Tampa Fair Grounds, Saturday and Sunday, October 16th and 17th. Awards galore. Plenty of free parking. Fun for all. Fully air conditioned.

NEW HAM MAGAZINE: Interested in public service, humanitarian action and international friendship? Sample issue free. Worldradio, 2509 Donner Way, Sacramento, Calif. 95818. WB6AUH.

SWAP: Nikormat FTN. 55 mm 1.2 lens, 250 mm zoom tele, 28 mm wideangle. Strobe, custom case. Mint condx. Want YAESU FRDX & FLDX 400's. WB8FUG, 615-548-7587.

CRYSTALS for Regency, Drake, Varitronics, Standard, Galaxy, Tempo FM transceivers and police receivers. Receive – $4.50, Transmit – $5.50, postpaid. Crystals for all applications available – WRITE! Quick Delivery. Derrick Electronics, Box 457, Broken Arrow, Oklahoma, 74012.

CANADIANS, All makes of Japanese Equipment, with LOW, LOW prices. FREE Illustrated Catalogue. Glenwood Trading Co., Dept. A, 4819 Skyline Dr., North Vancouver, B.C.

SWAN 350-C TRANSCEIVER, 550W SSB/CW/AM with sidetone, calibrator, and 117-XC power supply. Excellent condition, must sell. $275 F.O.B. Denver. Jordan, 7185 South Birch Way, Littleton, Colo. 80122.

TELETYPE PICTURES FOR SALE. Vol 1 $1.00. Vol 2 $2.00. Vol 3 $1.50. All for $4.00. Perforated tapes available. 200 different pictures. W9DGV-C, 2210-30th Street, Rock Island Illinois, 61201.

ELECTRONIC ORGAN full spinet, transistorized, two manual. SASE for particulars. Lloyd G. Hanson, W9YCB, RR2, Box 52A, Angola IN 46703.

GE POCKET MATE. .94/.94 $175; Motorola station monitor T1131A with 80 commercial band crystals $200. Bob Hines, 12914-88th Ave. N. Largo, Fla. 33542, 813-392-8642.

"1971 TESTS-ANSWERS" for FCC First and Second Class License – plus – "Self-Study Ability Test." Proven! $9.95. Satisfaction guaranteed. Command, Box 26348-S, San Francisco 94126.

DRAKE STATION for good price: TR-4 transceiver, RV-4 remote v.f.o., pwr supply and all extras thrown in for buyer; WB2PFY; 212-631-3711; 215-33 23 Road, Bayside NY 11360.

SAROC Seventh Anniversary January 6–9, 1972. Advance Registration $9.00 per person entitles registrant to SAROC Special room rate $12.00 per night plus room tax, single or double occupancy, effective January 4 thru 12, 1972; tickets for admission to technical seminars, HAM RADIO MAGAZINE and SAROC Happy Hour Thursday, SWAN ELECTRONICS and SAROC Social Hour Friday, HY-GAIN/GALAXY ELECTRONICS and SAROC Champagne Party Saturday, Buffet Hunt Breakfast, Sunday. Ladies who register will receive transportation for shopping tour, luncheon and Crazy Hat program at the New Union Plaza Hotel downtown Las Vegas, Saturday. Advance Registration, with Flamingo Hotel mid-night show two drinks, $14.50. Advance Registration, with Flamingo Hotel Dinner Show (entrees Brisket of Beef or Turkey) no drinks, $17.50. Tax and Gratuity included except for room. Frontier Airlines SAROC group flight package planned from Chicago, St. Louis, Omaha, Denver, send for details. Fifth National FM Conference, ARRL, WCARS-7255, WPSS-3952, MARS, meetings and technical sessions scheduled. Accommodations request to Flamingo Hotel, Las Vegas, Nevada, before 15th December. Advance Registration to SAROC, Southern Nevada ARC, Inc., Box 73, Boulder City, Nevada 89005, before 31st December.

EXCITING LISTENING! Police – Fire – Emergency Calls on your broadcast radio, $19.95 up. Also crystals, receivers, scanners, dual/-band. Salch Company, Woodsboro 5, Texas 78393.

RADIO ADVENTURE! Thrill to the amateur radio adventures of Tommy Rockford, K6ATX, in SOS AT MIDNIGHT, CQ GHOST SHIP, DX BRINGS DANGER – all time favorite novels by Walker Tompkins in colorful new editions. Order individually at $2.45 plus 25¢ postage and handling, or all three for only $7.00 postpaid. Utah and California residents add sales tax. Send check or money order to PEREGRINE PUBLISHERS INC., Dept. 73, Box 30565, Santa Barbara, California 93105.

WEST COAST HAMS buy their gear from Amrad Supply Inc. Send for flyer. 1025 Harrison St., Oakland, Ca. 94607. 451-7755, area code 415.

2-METER FM IC-20, solid state, state of the art, fully Xtaled, w/mike, mmount, & other accessories. $220. Bob Brunkow, 15112 S.E. 44th. Bellevue, Wa. 98004.

A TRANSFORMER for linear builders. Tapped 115 v.pri.Sec 1050 v at 1 amp. C.T. Can be used in bridge circuit for sweep tube or in a doubler circuit would furnish over 2900 volts at 500 ma. for zero bias triodes. Sealed case. $14.95 plus shipping. Wt. 47 lb. Can be shipped via U.P.S. A.R.C. Sales, 181 E. Wilson Bridge Rd., Worthington, Ohio 43085.

APC-75C 4.6–75MFF CAPACITORS – 5/$1. 5½" x 13" computer boards loaded with parts, rack mount and handle – 2/$1. Catalog 10¢. Trades accepted, any size, write: Electronic Systems, P.O. Box 206, New Egypt, NJ. 08533.

NU SIGMA ALPHA International Amateur Radio Fraternity. Membership now available. Includes wall certificate, I.D. card, newsletter, and more. Send for free brochure. Box 310, Dept. 73, Boston MA 02101.

SIMPSON 2M FM FOR SALE. FCC type accepted, solid state, 5 channels, 8W out, .2μV receiver. T. McLaughlin, WB4NEX, C. Box 622, North Manchester, Indiana 46962.

ELIGIBLE VETERANS build and keep a 25-inch Heath solid state color TV as part of a Bell & Howell (DeVRY) home study course. GI Bill pays 100% of the course and kits costs. Contact Bill Welsh (W6DDB), 234 S. Orchard, Burbank, Calif. 91506.

GALAXY FM-210 w/Power Supply, Mobile Bracket, Three Sets Xtals. Unit has all engineering changes, will not drift. $165.00. P.O. Box J, Lincoln, R.I. 02865.

Wide-Range RF Milliwattmeters Using HCDs

Frank C. Jones W6AJF
850 Donner Ave.
Sonoma CA 95476

The present low price of about one dollar for hot carrier diodes HP2811 or 2800 helped greatly in working out the two rf milliwattmeters shown in the circuits and photographs. They cover the range from audio up to 450 MHz.

A milliwattmeter is extremely useful in checking the output of any transistor or tube oscillator such as those used in transmitters, vfo units, receivers, and VHF converters – providing the oscillator has a 50Ω output connection. A temporary 50Ω output connection can be made to any oscillator, doubler, or tripler tuned circuit by one or more turns of wire around the coil and running the rf output to the milliwattmeter through a short lead of coaxial line. If a measurement at any frequency shows a milliwatt or two into a 50Ω load, one can be reasonably sure of enough rf injection even into a high-impedance mixer. Some FET mixers require about 5 mW injection, so if the measurement into a 50Ω rf milliwattmeter indicates this amount is available, most of the tedious work is done in designing or checking this part of a receiver or transmitter. A vfo frequency control unit may need to have constant output over its whole range. Measurements of rf power over the whole range is needed in this case which may only take a minute or two. The time to iron out vfo irregularities is something else!

The parts needed in a simple rf milliwattmeter are relatively few in number and moderate in cost. The microammeter is used only as a reference indicator so no scale calibration is required. A black line of the meter face cover at the desired 5 or 10 or 15 μA is all that is needed. The rf power calibration is made on the dial or scale of the high resistance variable resistor or potentiometer such as used for af gain controls.

The HP2811 (or 2800) hot carrier diode is remarkably uniform in characteristics from unit to unit. It is also usable with a forward bias dc voltage which greatly increases its sensitivity as a detector. All diodes have a minimum voltage below which the rf current flow is too low to be useful in a microammeter which is a current indicating device. If an ordinary diode has forward bias it may become a good noise generator, or erratic in operation. The diodes used in these rf meters work very efficiently with some forward bias from a small 1.5V battery. The current through the diode is limited by a series resistor of some value between 180 and 200 kΩ. The dc path is completed through the diode and the rf terminating resistor of 50–51Ω. This bias voltage also causes a current to flow through the microammeter, which preferably should be balanced out for low rf power measurements. This current is greatest when the power indicator variable resistor is set to minimum resistance.

By balancing out this current by means of a screwdriver-adjustable potentiometer so the meter reads zero with no rf power input, one reference line on the meter face can be used for any rf power input at any frequency. The dc drain on the battery cell is a value of less than 1 mA when making measurements, but the life of the battery

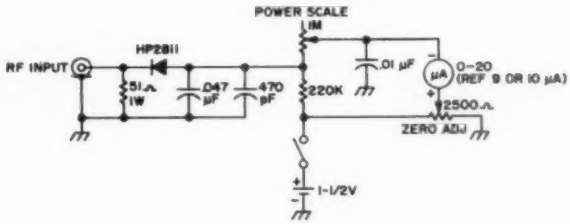
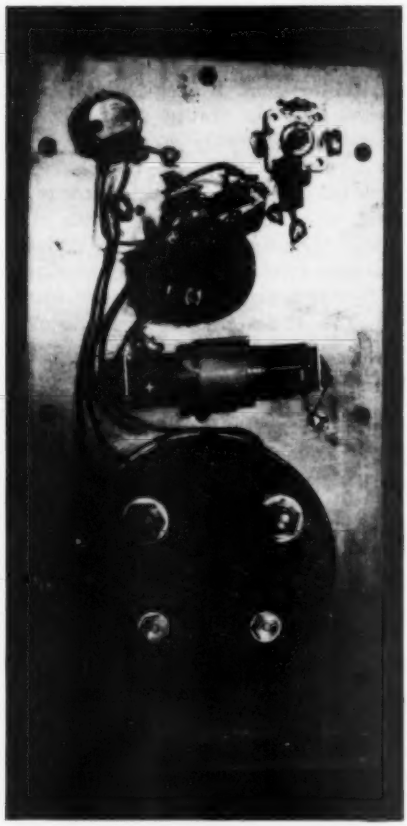


Fig. 1. Schematic diagram of 0.05–500 mW wattmeter.

can be extended greatly by having a switch in this circuit.

The 51Ω 1W resistor (Fig. 1) should be a noninductive, carbon or metallic film type suitable for rf service. Actually a ½W type has a little better rf characteristic but no resistor should be used at full rating. This terminating resistor is soldered across the BNC rf input fitting with as short leads as possible. The diode and its parallel bypass capacitors are also mounted at this input jack. All other components can be mounted anywhere on the 4 x 8 x 2 inch chassis panel (or other sized case if desired).



.05 to 500 milliwattmeter, underside view of completed 4 x 8 board mounting.

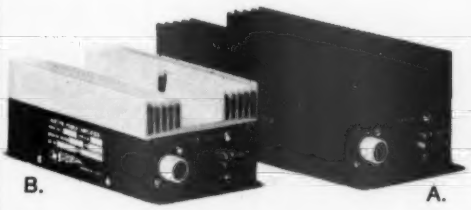
In the other higher range rf meter (Fig. 2), the rf resistor consisted of two resistors in series with short leads across the BNC input jack. A 39Ω 1W and an 11Ω ½W resistor in series make up the 50Ω rf load. The diode is tapped into this resistor in order to keep within the 15 or 20 PIV rating of the HP2900 or 2811 diode. (An HP2800 with its 75 PIV rating could be used across a 50Ω resistor.)

Parallel bypass capacitors were used from diode to ground of the input jack in order to use the instrument over the whole range of 50 kHz to 450 MHz. With even larger bypass values in parallel, the milliwattmeters could be used throughout the audio range as well; amd calibration of the power scale resistor could be made more easily. A sensitive af or low rf voltmeter and an oscillator within the voltmeter frequency range can be used to calibrate the devices. The oscillator needs to have an attenuator, a low impedance output, and a power output of up to 1W for connection to the milliwattmeters through a piece of 50Ω coaxial line. Calibration measurements can be made using the low-power stages of a 450 and 144 MHz transmitter limited to about 500 mW. A series of 3, 6,

More good news from Tempo

THE ALL NEW, TOTALLY UNIQUE, TEMPO CT 220 TR FM/AM TRANSCEIVER

Don't let its small size fool you (it's only 7" wide). This little giant outperforms its big brothers. Look at these specifications... then look at the low price. Completely solid state. 220 to 225 MHz operation. Transmitter: Positions for 5 internal crystals (not supplied). 1 external crystal position and VFO input. Power Output: 4 watts FM, 1½ watts AM. FM internally adjustable to 15 kc. Power Requirements: 13.8 VDC XMT 1.2 amps FM, .5 amp AM, 25 ma Stby. Receiver: Tuning Meter for AM and FM. .6 micro-volt for 20 db quieting. Tunable or pre-set to five internally adjustable frequencies. FM is detected by limiter discriminator, 6 db at 15 kcs. 1 watt audio output — 5% distortion. Double conversion, 10.7 MHz and 455 KHz. ACCESSORIES AVAILABLE: AC Power Supply & Speaker. Internal amplifier to increase output to 20 W FM and 8 W AM. External VFO. External high power amplifiers for FM operation. (CT 220-40 or CT 220-80 suggested.)
Introductory price: $179.00



B. A.

TEMPO CT HIGH POWER VHF 2 METER AMPLIFIERS ... COMPACT AND HANDSOME

A. The CT 1002-2; Operates directly from a 12 VDC power source. Antenna switching is automatic when as little as 1.5 watts of RF drive is applied. The amplifier incorporates Balanced Emitter transistors and state of the art design practices, making it virtually immune to destruction due to high VSWR or misloading conditions. It may be used anywhere in the 2 meter band without the necessity of retuning. Only 9⅜" x 4" x 3", the CT 1002-2 can be installed almost anyplace. Since there are no switches or meters, it may be mounted under a seat, in the trunk or in a desk drawer. SPECIFICATION: Power output: 100W. Input voltage: 13.8VDC. Current required: 12-14 amps. Drive required: 10W. Price: $220.00

B. The CT 602-2: A superior quality 60 watt VHF FM 2 meter power amplifier measuring only 6½" x 3½" x 3". $145.00

TEMPO CT OFFERS THE MOST COMPLETE LINE OF AMPLIFIERS AVAILABLE TODAY

MODEL NUMBER	POWER INPUT	POWER OUTPUT min.	BAND	MODEL NUMBER	POWER INPUT	POWER OUTPUT min.	BAND
CT6-30	1 to 10 W	30 W	6 M	CT252-A2	1 W	25 W	2 M
CT6-60	1 to 10 W	60 W	6 M	CT352-2	8 W	30 W	2 M
CT6-100	1 to 10 W	100 W	6 M	CT220-40	4 W	40 W	220 MHz
CT1202-2	25 W	125 W	2 M	CT220-80	4 W	80 W	220 MHz
CT1002-2	5-10 W	95-100 W	2 M	CT445-1	100 mw to 300 mw	1 W	440 MHz
CT602-2	5-10 W	60 W	2 M	CT445-5	200 mw to 1 W	5 W	440 MHz
CT606-B2	1 W	60 W	2 M	CT445-15	1 to 5 W	15 W	440 MHz
CT452-2	5-10 W	45 W	2 M	CT445-30	1 to 10 W	30 W	440 MHz
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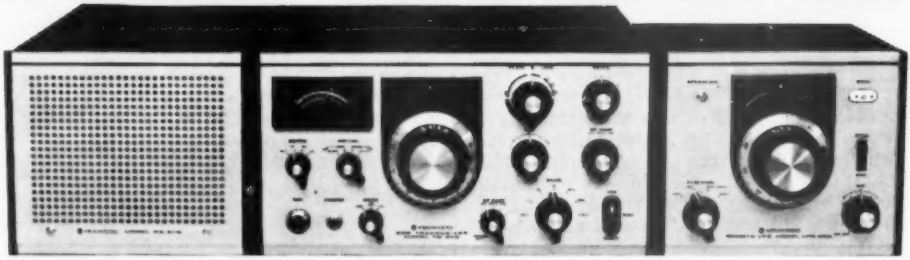

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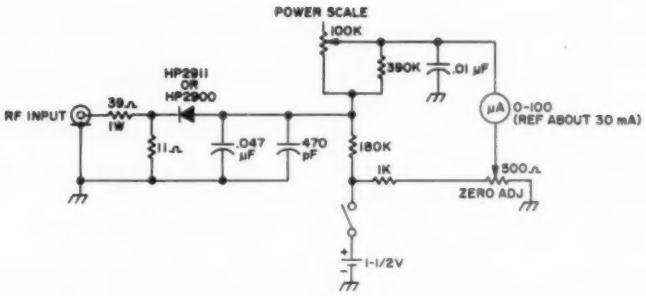
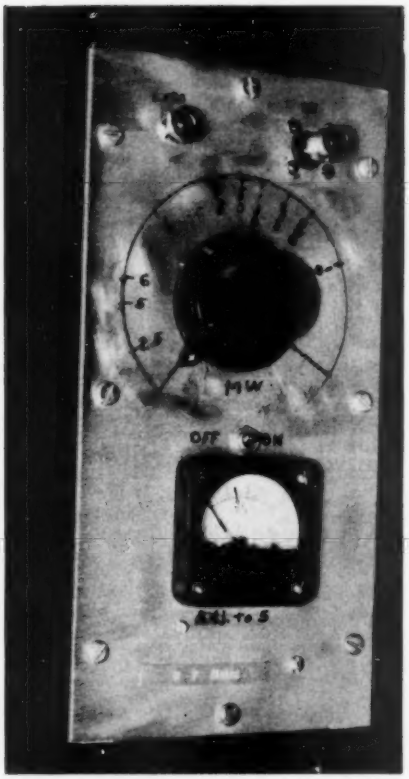


Fig. 2. Schematic of milliwattmeter for measuring rf power levels of 1–1000 mW.

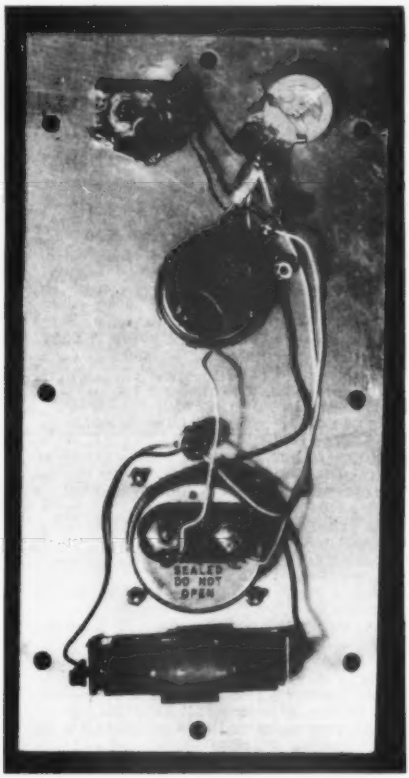
10, and 20 dB resistor pads (1W maximum ratings) with 50Ω impedance values are then cut into the coax line to check calibration points at 144 and at 432 MHz. The maximum errors should be less than 15% and at most frequencies, much less.

The component values shown in Fig. 1 resulted in an instrument having a range of .05 up to 500 mW. The low end of the power range will depend on meter resistance to some extent.

The unit shown in Fig. 2 used a small



1 to 1000 milliwattmeter top view, 4 x 8 x 2 inch case.



1 to 1000 milliwattmeter bottom view.

square microammeter without microampere calibration but the full-scale deflection point seemed to be a little over 100 μA. The reference line of rf power indication was simply a black ink line on the face of the meter. The popular imported 50 μA meters may be used in this same circuit though the higher meter resistance may prevent getting down to less than 0.25 mW readings in the circuit of Fig. 1. The minimum reading of 1 mW up to 1W or the unit in Fig. 2 may be easily obtained with nearly any range of microammeter and "power indicating" resistor. This variable resistor or potentiometer can be nearly any size of af gain control with its maximum resistance either limited by a shunt resistor or by the pot value itself, depending on the range or reference value of the microammeter.

This resistor scale was hand calibrated on an aluminum panel in the higher-range instrument and on a brown Bakelite copper-plated board in the low-range unit.

The zero adjustment circuit of Fig. 2 with a 500Ω pot and a fixed 1000 or 1200Ω resistor makes it an easy matter to zero the meter. Less than 500 mV of bias is needed for the meter circuit. A few microamperes of forward bias current through the diode is enough to enable measurements down to a small fraction of 1 mW.

About 30 different germanium and silicon diodes were tried in these circuits. Even the "fastest" computer diodes were not very good at 450 MHz. These function but at lower efficiency than at HF or VHF – so the power scale error becomes objectionable. The hot carrier diodes were much better.

. . .W6AJF■

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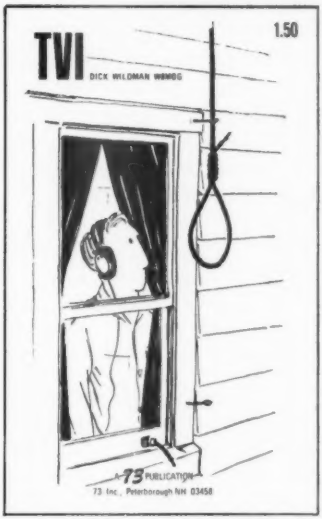

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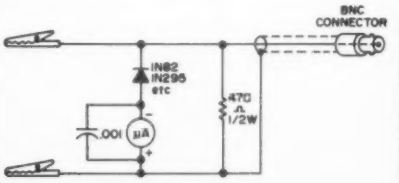
OOPS!

We did it yet again . . . actually allowed a mistake to get into print. This time, it was on page 25 of the July issue of 73, in a short article by Walt Pinner WB4MYL, called "Dipper Thing." In some unaccountable way, the schematic accompanying the article was incorrect. At vast expense, we have had it redrawn, and herewith give you the correct version.



Bill Hoisington K1CLL
Far Over Farm
Peterborough NH 03458

Signalling through Space Without Wires

. . . Sir Oliver Lodge before the Royal Institute, London, 1934.

This is *not* another history. It is a list of the remarkable discoveries made in the previous century and left to lie in the dust for some thirty to forty years, or more.

Introduction

The title describes admirably the main effort of all amateurs today. Several decades before the turn of the century, however, these "Maxwellian" waves, or "Hertzian" waves as they were called after the famous German experiments of 1887–1889, made themselves known and were recorded in various publications and letters of the times, as effects, nuisances, phenomena, etc. Note that this was in the decades *before* Hertz.

Any of a number of people *could* have had electromagnetic radiation named after themselves instead of Hertz! All they needed was a little more persistence and a little more long-time research in the face of criticism and ridicule. Of course, that isn't always easy. Sir Oliver Lodge was one of these, and admits several times later his regret at not having followed up certain experiments which showed him the existence of such waves at least a decade before Hertz.

A Civil War engineer signaled 11 miles using electromagnetic waves in the 1860s. Certain patents were taken out, and many people encountered these "unexplainable effects," all before 1887. Some of these are well recorded, such as those taken from Lodge's book whose title is the heading of this article.

An American named Henry was prominent during the period of 1850. He at least got his name perpetuated. He magnetized a steel needle at 30 yards.

It is important to remember that most of the famous names in science of those days in various countries were expert chemists, opticians, astronomers, glass blowers, and metal workers, as well as scientists. They had to be! No technicians were around to do those odd jobs.

Working myself in this field (radio) since 1921, it was my privilege to experience the "rediscovery" of many electromagnetic phenomena through the years preceding and during WW2. Some of these

were high-power microwave pulses, cavities, highly directional beams from parabolic reflectors, powdered iron cores, plug-in coils, and a host of others. Most of these were more or less discarded in the rush for better methods of *frequency* separation from about 1900 on. Not until WW2 threatened did England really push microwaves and radar, which encouraged and promoted a resurgence of pulses, parabolic reflectors, etc. Let us look at this list, which to a great extent reads backwards in time as the "rediscovery" takes place.

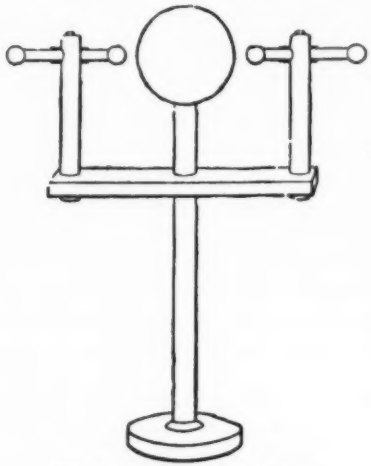


Fig. 1. Lodge's spherical antenna.

The spherical radiator

In 1890 considerable use was made of the spherical radiator. This was first used by Lodge, I believe, improved by Professor Righi of Bologna, and adopted later by Marconi. It is shown on page 25, and Fig. 1 is a reproduction of this "antenna." High voltage was applied to the side spark balls and these discharged over to the spherical radiator which then accumulated a positive wave on one side and a negative wave on the other. This distribution of energy on a sphere, which obviously could not be maintained there for more time than it takes a wave to travel to the midpoint, or equator, was then radiated into space in the form of a very highly "damped wave" (as it was called in those days).

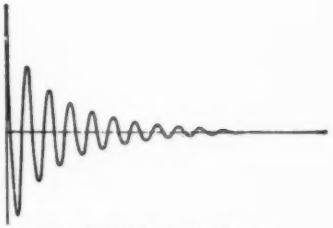


Fig. 2. Highly damped wave.

Page references here are from Lodge's book and lecture of 1894 before the Royal Institute, in London, from which book I have borrowed the title of this article.

Lodge said, page 3, "If the body receiving these waves has its natural or free vibrations violently damped, so that when left to itself it speedily returns to rest, (our Fig. 2) then it can respond fully to notes of any pitch." In other words it is so loaded that it has an extremely large bandwidth. The "bandwidth" of a sphere is actually so large that it becomes almost meaningless to speak of it in terms of frequency.

The contrary, or sharp tuning, is described as follows, "If, on the other hand, the receiving body (antenna) has a persistent period of vibration, continuing in motion long after it is left to itself, great accuracy of tuning is necessary . . . ."

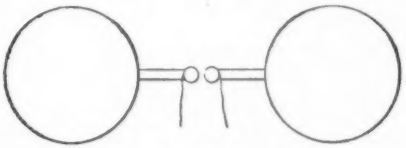


Fig. 3. Standard Hertz radiator producing the wave of Fig. 2.

Antenna radiation versus "Q".

A "standard Hertz radiator" is shown in Fig. 3. Here's what Lodge said about it: "In consequence of its radiation of energy, its vibrations are rapidly damped, and it only gives some three or four good strong swings." For the 1 in. spark balls sometimes used then, this corresponds roughly to frequencies near 5 GHz and pulse lengths of the order of 1 ns.

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short amount of time involved, but they had not yet invented radar!

High power

Giving his demonstration at the Royal Institute in London, Lodge said of radiation, "Here is a great one, giving waves of 30 meters long (10 MHz) radiating while it lasts with an activity of 100 hp, and making 10,000,000 complete electric vibrations per second. Its great radiating power damps it down very rapidly so that it does not make more than two or three swings." He had demonstrated a 700 kW pulse of 0.2–0.3 usec – and he knew it!

Cavity oscillators

Lodge also discovered cavity oscillators. He said, "A hollow cylinder . . . (is) a feeble radiator, but a persistent one." His figure in his own book is followed by the description, "emitting three-inch waves." Well, 3 in. equals 7.5 cm – and that is some 4 GHz (4000 MHz). Not bad for 1894!

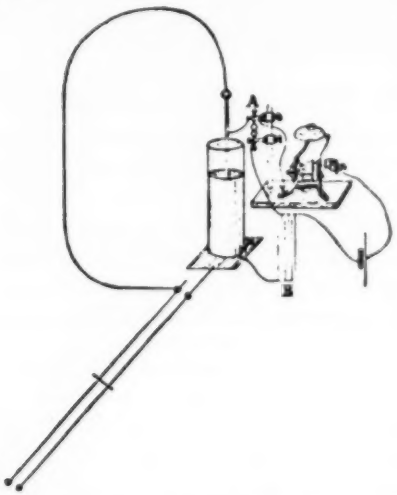

Fig. 4. Lodge's tuned lines and receiving gear.

Tuned lines

Lodge's tuned lines are shown in Fig. 4. The coherer detector and bell ringer are also shown, but enough has been said in histories about those. These tuned lines were quite the rage in the good old 5 and 2½ meter days before the war, which era was some 40 years later!

DX

In describing some of his earlier experiments, Lodge noted, "Signals were obtained across the full width of the college quadrangle, and later with larger apparatus, between the college tower and another high building half a mile away." I consider a ½ mile to be good DX for a coherer. No tubes, no amplifier!

UHF Bow-Tie Antennas

Our Fig. 5 shows Lodge's "bow-tie" antenna, a style that never went out. There are thousands of these all over the country now. They receive UHF TV, some 70 years later!

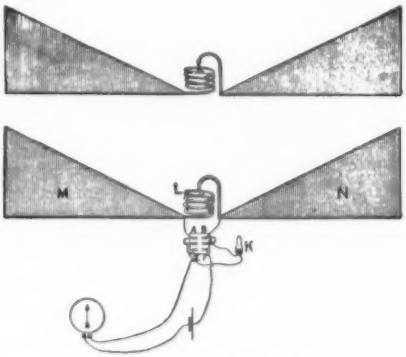

Fig. 5. Early "bow-tie" antenna.

QRM

I found nothing that could be called QRM (how could there be, nobody else was on the air!) but, while he was operating a very sensitive coherer and galvanometer assembly as a detector, he noted " . . . a sensitive coherer in an outside shed unprotected by the thick walls of a substantial building cannot be kept quiet for long."

Completely shielded receiver

To anyone with visions of catwhisker detectors spread out bare on the kitchen table, I can only say, that was *much later*. Lodge knew a lot more about what he was

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doing, as you can see: "If a coherer is shut up in a complete metallic enclosure, waves cannot get to it . . . Clamping a copper flange in six places was not enough." He *really* must have had a sensitive detector. And a 0–1 μA meter maybe.

Other Technological Firsts

Microwave, prisms and lenses, cavity detectors, and oscillators (from Lodge's book) are all shown in Fig. 6. Little comment is needed on this list other than to say that most of these microwave items were left to lie mainly unused afterwards for some 35 to 40 years!

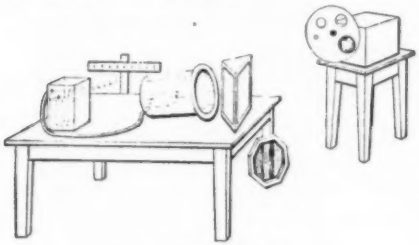

Fig. 6. Early UHF gear.

As to why they should have lain "in the attic" all this time, that is another story. A scientist of those days had a tradition of separation from "mundane" affairs to maintain. This gave Marconi the chance to grab hold of things, which he did without hesitation.

In Marconi's day, the big and expensive battleships and ocean liners were sailing the high seas with absolutely no communications of any kind! It's hard to imagine, but fact. So of course this was one of the first applications to develop, and one which of course set a premium on *long distance*. Not line-of-sight microwaves. This soon led to the use of low frequencies, as signals crackled across the Atlantic, just after the turn of the century.

Lens antennas

Lodge described the power gain of a lens antenna: "An ordinary 9 in. glass lens is next placed near the source, and by means of a light taper (candle) it is focused between source and receiver. The lens is seen to *increase* the effect by *concentrating* the electric radiation." *This* one I use myself in an X-band reproduction of the human eye. Incidentally, I have been at this little invention since 1951 and nobody, but just *nobody*, believes you can see via microwaves – even though a lens antenna *does* furnish a real, exact image on a microwave retina placed on the curved focal plane in back of the lens!

Marconi Learns About "Wireless Telegraphy"

Who learned from whom? Well, Lodge started the ball rolling. He said, "In Italy, the work described in the lecture became well known, and the subject was developed largely, especially by Prof. Righi, of Bologna . . . It appears that it was from him that Signor Marconi learned about the subject and immediately conceived the idea of applying it to commercial telegraphy." He also followed up the idea! And I should think he did learn from Prof. Righi, since this learned gentleman was Marconi's teacher!

Powdered iron cores

I remember well my own first sight of a powdered iron core. It was in Paris, where I had a small factory making radios. The year was 1933, and considerable interest was stirred by an "iron core" for a radio coil. But Lodge was there first! Speaking of cores inside coils, he found that the conductivity of massive iron makes an "unsuitable substance," and instead used a mixture of iron filings "chemically reduced." He also uses the words "chemically obtained" and "iron powder with paraffin."

A Recent "Overlooked" Discovery

An engineer at GE named North was working on *welded* (junctions?) microwave crystal detectors during the war, and appears to have made some which oscillated under certain conditions of bias. However, oscillation in a 30 MHz i-f strip was not desired at that time, and this early diode (transistor) oscillator was only revived in the 1950s.

Perhaps there are still some engineers around who can tell us more about *this* item.

KICLL■

Peter A. Stark K2OAW
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An Instant FM Repeater For *EMERGENCY USE*

Most repeaters are fairly complicated affairs which take a lot of time to plan and build. Very often, though, a portable repeater which could be set up almost on a moment's notice may come in handy. This might happen in an emergency when the area needing coverage has no regular repeater or when the regular repeater has been damaged; it could also happen when a special event, like a road rally or exhibition, is planned and a repeater is needed to extend coverage. Here is an idea for an instant FM repeater which can be set up in a few minutes, moved anywhere needed (as long as there is a road leading to the site) and dismantled just as easily. And, in a pinch, one man can carry it up the hill.

Figure 1 shows the complete diagram of the control unit; hook it up to any two mobile FM transceivers, and a complete repeater is in operation. All it does is to key up one transceiver when the other one receives a modulated signal. In emergency operation, two mobiles meet on top of a hill, connect the control unit between their two mobile rigs, and they're on the air. The repeater does not have any time-out timers, no logging, and none of the other fancy control gimmicks needed for full-time operation, but it will repeat and repeat well.

As shown in Fig. 1, the audio signal from the receiving transceiver is connected to the audio input. To make sure that no connection other than audio is needed, the control panel operates on the presence of audio. The audio input comes directly from the speaker; most small transceivers have the speaker leads brought to a connector on the rear, in which case only a plug is needed. Otherwise, a clip-lead connection to the speaker terminals will do.

The audio signal is applied to two 1 kΩ potentiometers. The audio level pot controls the volume which is applied to the mike input on the transmitting transceiver. It's only necessary to adjust the volume so that the modulation sounds right.

The audio is also picked off the trigger level pot, and amplified by transistor Q1. It is then sent to the base of Q2. Because Q2 has no base bias, it is normally cut off so that the collector of Q2 is around 12V. But when audio appears, the signal on the base of Q2 turns it on very quickly, and the 150 μF capacitor charges to 12V. This applies base bias to transistor Q3, which in turn operates the relay. When the last bit of audio disappears, the capacitor takes about 1 second to discharge and release the relay.

In normal operation, with no received signal, the squelch on the receiver keeps the audio off, and the relay in the control unit is not energized. As soon as a signal is

received, the squelch opens and the audio is applied to the control unit. The relay then closes and stays closed until about 1 to 2 seconds after the last audio has come in. The delay is long enough that the relay stays closed even between words and sentences. (The use of audio instead of a squelch voltage would not be good for a permanent repeater, but for emergency operation it has the advantage of working with any receiver.)

When building the control unit, make sure to bypass all leads going into the unit. The circuit should be built into a tight shielded minibox or other enclosure, with all input and output leads bypassed (feedthrough capacitors are just fine). The idea is to keep the transmitted rf from getting into the box and causing false triggering. The battery can be built-in too, since the current gain is only 2 mA during wait periods, and reaches only about 10 mA during transmit, depending on the current drain of the relay. The higher the coil resistance, the better for the battery.

Desensing is not as much of a problem as might appear, since the two mobiles can easily be positioned several hundred feet apart. The control unit should be located next to the transmitting unit, to keep the switching and mike leads short; the speaker leads are at a low impedance and can be twisted lampcord without any hum pickup. But rf shielding is important where the leads enter the control unit to prevent false triggering.

While waiting for that emergency to develop, this control unit can be used for other tasks as well – here are just a few suggestions. If you like to "read the mail" on your FM channel, why not hook it up between your transceiver and a tape recorder. Whenever a signal appears, the recorder will turn on and record. It's great for knowing what goes on without sitting around waiting for something to happen. The input can also come from a monitor receiver or from a receiver strip; the important thing is that the receiver have a squelch circuit to cut off the audio when there is no signal.

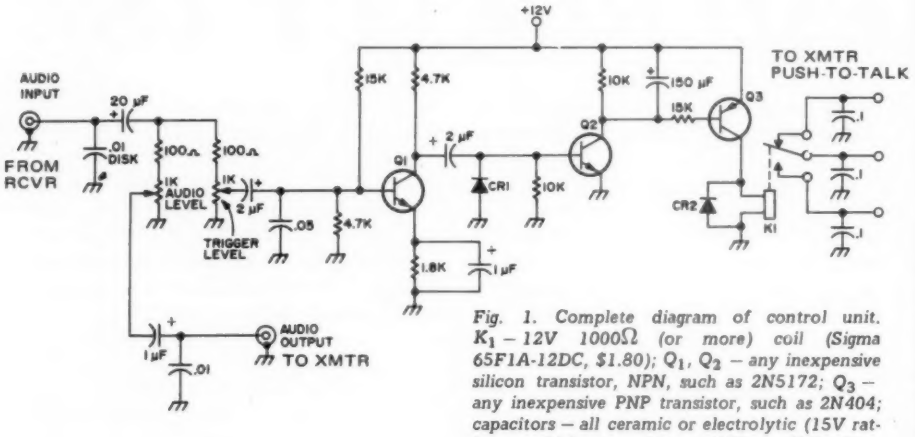

Fig. 1. Complete diagram of control unit. K_1 – 12V 1000Ω (or more) coil (Sigma 65F1A-12DC, $1.80); Q_1, Q_2 – any inexpensive silicon transistor, NPN, such as 2N5172; Q_3 – any inexpensive PNP transistor, such as 2N404; capacitors – all ceramic or electrolytic (15V rating or higher); resistors – ½W or ½W; CR_1, CR_2 – any small germanium or silicon diode.

Another cute application is to connect the control unit between a telephone line and a tape recorder. That way, any call on the line will be recorded. Or it can be connected between the telephone and a small transmitter. Or between a room mike and a tape recorder. In these cases some additional amplification or isolation from the phone line may be needed, but this is fairly straightforward.

Whatever you do with it, it's a handy thing to have around.

. . .K2OAW■

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Oakville, Ontario

IT' It's The Real Thing

Power supplies are necessities to every ham, but most hams hesitate to buy one. They would rather build it since it's cheaper that way. It's just a bit of wiring and drilling – so why not?

Some hams dive into their junkbox and design a supply, depending on what parts they have. Others take a look at various "73" issues and build it accordingly, for after all, there are lots of versions in "73." Some authors emphasize low cost, others good regulation. Some are simply versatile and can be used for everything. And then, of course, there are the transformerless ones (for those who really ask for TVI).

By now I have built quite a few supplies, from "low cost" to "versatile," the fancy regulated swinging choke types, and made 600V from the 115 ac line. (Always kept my eye on the dollar bills.)

I copied guy "A's" low-cost supply, using two TV transformers because they were in my junkbox. My 300V B+ turned out to be 400V, unfortunately. And after I blew my 1 kV diode-bridge across the 700V CT winding, I ended up with 1.1 kV on the 900V rated electrolytics. They lasted anyhow. At 200 mA load current, the transformer got red hot. However, it kept my transmitter going, using both 6.3V heater windings.

Equipment changes required a new supply. SSB was on the list, so I bought a swinging choke for $13, a new, bigger chassis and a heavier heavy-duty TV transformer. This one had 600V ac only. Using the choke input circuit, I ended up with 650V dc only, which was a little low. I added a small 120V/500 mA job at the back of the chassis and put it in series with the TV transformer, and there I was with a beautiful 780V dc. Voltage hardly changed from *no load* to *full load*. The only trouble was that the bleeders heated up the chassis with 22W – but who cares – it cut down on fuel oil bills, hi. Well, it worked just fine. It was big, of course, and when I added up dollars and cents, it wasn't that cheap at all (but lots of little expenses don't hurt as much).

Time passed and equipment changed. I sold the whole monster with transmitter and everything. The rig ended up as a CW transmitter anyhow. That can happen with a lack of spare time, you know. But now comes the real thing: I had three month's time until I got my commercial rig, so I made a universal supply. It had any supply voltage that could possibly pop up in any piece of equipment, so I didn't rush. Thought I'd do it "proper" now, with an everlasting supply. Looking into friends' junkboxes – my own was empty – I ended up with a beauty. Put two 800V supplies in series (this gives 1.6 kV – I had that future kW in mind). I must admit, 2 kV looks more like it, but then . . .

To make a long story short, it was not the real thing. Now I've had it. I'm fed up. No more of those cheap, ultraregulated general-purpose supplies. They are bulky,

ugly, and not cheap at all.

Looking around, I noticed that average requirements for transmitters and transceivers are as follows:

700–800V dc @ 250 mA
275–300V dc @ 200 mA
–100V dc @ 10 mA
12.6V ac or 6.3V ac at 6 or 12A

So why not just buy a single transformer that does the job? I know, they are hard to come by. So I checked with a local transformer manufacturer and was surprised at the cost of it: only $24 for

300V ac @ 500 mA
480V ac @ 200 mA with centertap and taps at 70V from CT
12.6V ac @ 6A with centertap

the power amplifier. There you are! Do I hear remarks on the regulation? Okay, let's see. The 300V B+ is constantly loaded with 150 mA or so; therefore no regulation is required. The high voltage reads 840V no-load – 725V loaded with 200 mA. In SSB mode, where regulation is important, idle current is about 120 mA, and the voltage reads 760V, then. Peak current in SSB mode reaches, say, 400 mA, at which the voltage decreases to 700V at the most. Regulation therefore is –9%, and that's not bad, eh? For the CW man regulation is much worse; it is –20%. Looks bad, but you ain't gonna hear that unless it pulls your oscillator, which it shouldn't, anyway.

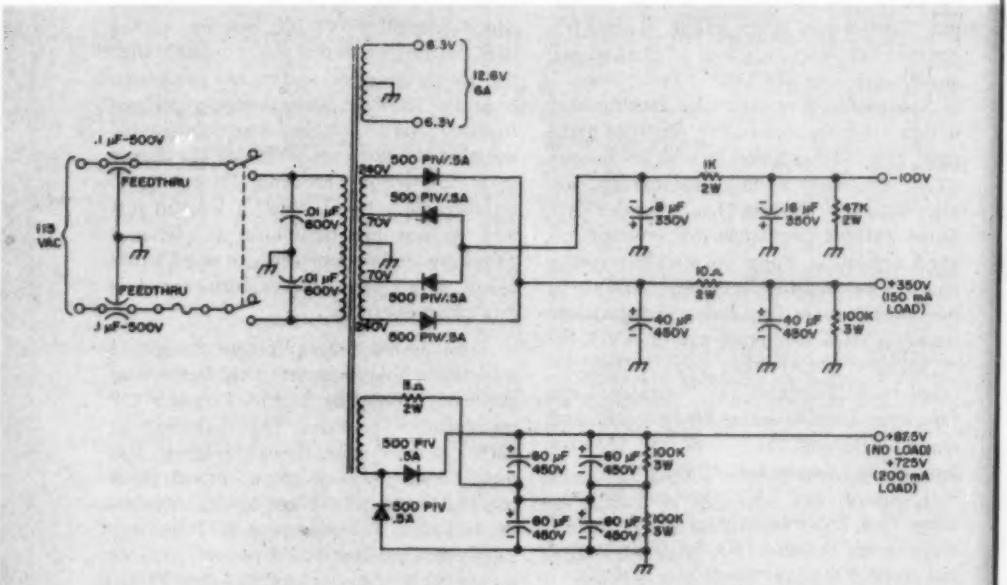


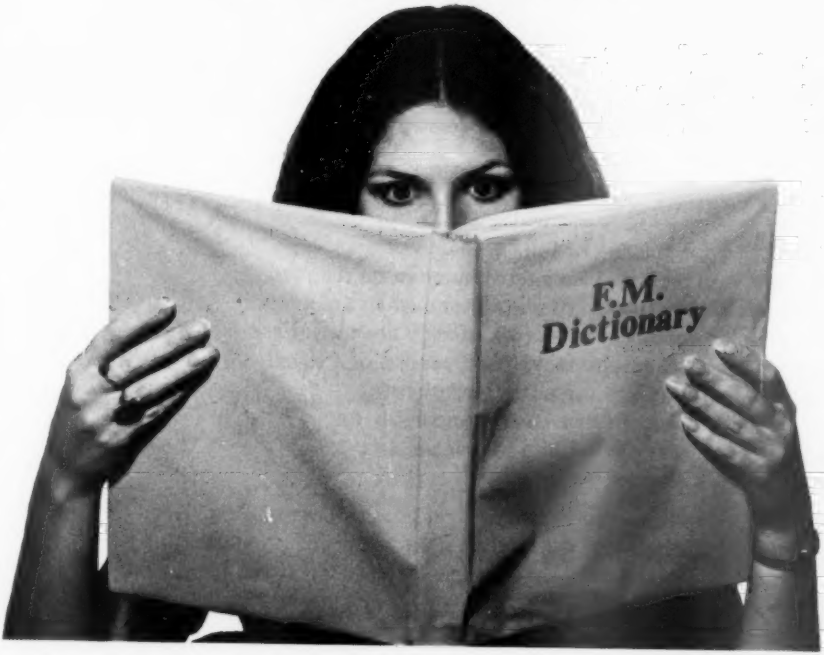
Fig. 1. Schematic of the suggested power supply.

Now look what you can do with it: There is all the filament power and versatility you could possibly need – 6.3V or 12.6V. You can get 300V dc out of it with two cheap 500 PIV diodes; –100V dc out by using two cheap 300 PIV diodes; make a full wave voltage doubler with two cheap 500 PIV diodes to get your high voltage for

So listen, if you build that cheap or else power supply for your rig, figure it twice, don't buy two heavy-duty TV transformers – buy the real thing. While you break even on the transformer costs, you save money on a smaller chassis and low-cost diodes.

. . . VE3GSP■

from Audio to Zener the newest word in the FM Vocabulary is TRANSCAN™



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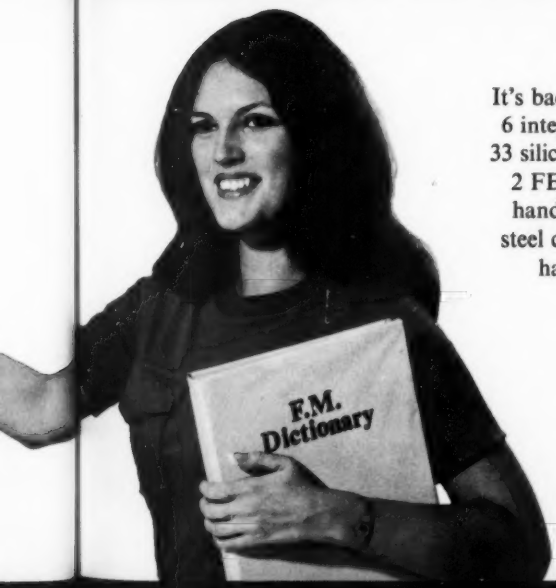

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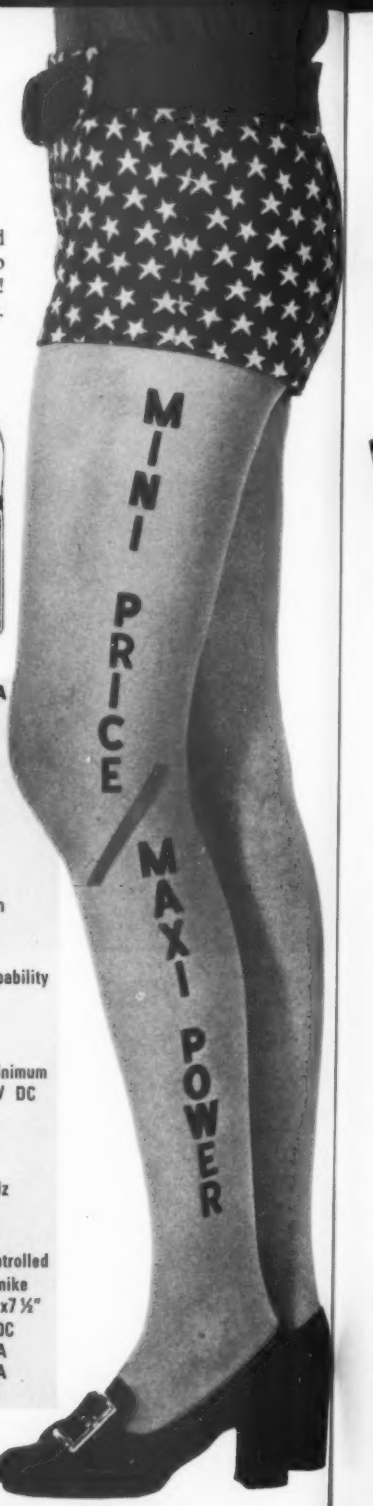
	HR-2S (Base Transcan)	HR-2MS (Mobile Transcan)	HR-2A
Receiver—double conversion, superhetrodyne			
Frequency Range	144-148 MHz		
Sensitivity	0.35μv (nom.) 20 DB quieting		
Selectivity	6 DB Down ± 16 KHz – 50 DB Down ± 32 KHz		
Image Rejection	45 DB		
Spurious Rejection	60 DB		
Modulation Acceptance	± 15 KHz		
Autio Output	5 Watts Maximum		
	New FET Mixer for Superior Intermodulation Rejection		
Squelch System	-All Electronic Noise Compensated		
I.F. Frequencies	10.7 MHz & 455 KHz (ceramic filter)		
Channels	8 crystal controlled	8 crystal controlled	6 . . . 12 capability
Scan Rate	15 channels per sec.	15 channels per sec.	
Transmitter—uses phase modulation, built-in SWR load mismatch circuitry			
Frequency Range	144-148 MHz		
Power Output	15 Watts Minimum @ 117 V AC, 60 CPS	15 Watts Minimum @ 13.6 V DC	15 Watts Minimum @ 13.6 V DC
Power Band width	144-148 MHz		
Harmonic & Spurious Emissions	55 DB, or more, below carrier		
Modulation	Phase, with automatic deviation limiting		
Deviation	Automatic Limiting, internally adjustable from 0-15 KHz		
Mike Pre-Amp	FET input with internal level control		
Microphone (supplied)	Plug-in, hand held, high Z ceramic		
Channels	8 crystal controlled	8 crystal controlled	6 crystal controlled
General—All prices include factory installed T & R crystals for 146.94 MHz and PTT mike			
Size-	13" x 9" x 8½"	10" x 4" x 8½"	2½" x 5½" x7½"
Power Drain	117 V AC	13.6 V DC	13.6 V DC
Receive (Sq.)	.2 A	380 MA	180 MA
Receive (Max).	.3 A	800 MA	800 MA
Transmit	.7 A	2.9 A	2.9 A



Regency ELECTRONICS, INC.

7900 Pendleton Pike • Indianapolis, Indiana 46226

METEOR SHOWERS: ON PREDICTION ACCURACY

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In the *VHF Handbook*, a table of meteor shower data includes information that relates to the relative speed of the shower particles as they enter the earth's ionosphere. What this says, in effect, is that not all particles enter the E layer at the same speed. In each case the particle entry speed is related to the relative position (and movement) of the earth and the particles. For example, a particle that enters the earth's ionosphere head-on will contact the E layer with much greater speed than a particle that must come up from behind and overtake the earth. In between these two extremes are particles that come at the earth from various tilted trajectories, where the combined speed of the earth and the particle may add to or subtract from the actual apparent speed of the particle.

One of the most important factors in determining at what height a particle heats up by friction and ignites a trail behind it is the speed at which it enters the E layer. The faster the particle's apparent speed, the quicker it heats to ignition in the layer. And the higher up in the layer that ignition occurs, the greater the skip distance possible, since skip distance is directly a function of the height of the refraction point.

A meteor *shower* is so named because an unusually large concentration of meteor particles entering the E layer during the shower period appear to come from the same region in space and at the same speed. Thus, during the annual Geminids shower in December there is a reported average particle speed of 35 km/sec. Because of the approach trajectory of the shower particles, we know that this shower is basically best for the north–south paths (because the particle trajectory enters the E layer along a basic north–south path). Because the speed is relatively slow (35 km/sec), the particles penetrate well into the E layer before the slightly denser lower portions of the E layer build the particle skin temperature high enough to cause ignition.

With the ignition point occurring *low* in the E layer, the skip distances covered during the Geminds are generally *short*

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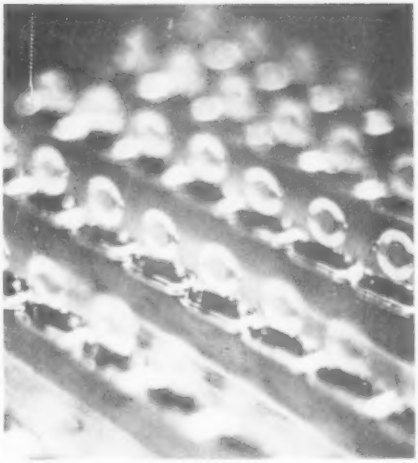

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(500–900 miles), because the refraction point (where the ionized column forms) is itself low in the layer.

On the other hand, the annual Arietids shower, peaking during the daylight hours on June 8, is a *fast* particle-speed event (70 km/sec). Here the particles tend to ignite *higher* in the E layer, and the distances covered are therefore generally from 900 to 1300 miles.

This becomes a most important factor in planning schedules on 144 MHz, since a great deal of time can be wasted looking for the wrong distances during the wrong shower.

The Right Direction

Over the years the table now appearing in the VHF Handbook (originally appearing in the April 1957 issue of QST) has been subject to some discredit by otherwise enthusiastic VHF meteor chasers. Actually, the table is quite accurate. What requires further refinement is the annual changes in the nature of these meteor shower events, and some explanation as to how the Optimum Paths/Times portion of the table was initially arrived at.

Anyone who has observed meteor propagation over the years recognizes that no given shower (not even the annual big daddy, the *August Perseids*) acts exactly the same every year. Since most meteor showers result from the crossing of paths the two paths do not cross at exactly the same point in space two years in a row. Most meteor showers are the result of long dead comets, where the debris remains in the same general solar orbit. Within the comet-left debris region, the distribution of the space particles is anything but uniform.

This table shows visual meteors as counted by the American Meteor Society. Its parallel to VHF radio meteors, as a general level of activity, has been verified by the author as "quite accurate." As a matter of practical concern, these sightings were taken between 3 and 4 a.m. standard time, but dovetail closely with the 5–7 a.m. radio meteor period. Counts under 20 are considered below par; 20–30 average to above; 30 and up are in the shower category (per-hour count).

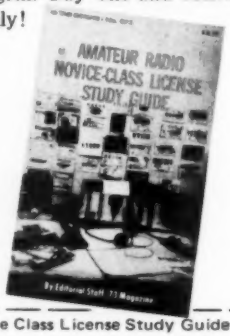
Date	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	19	24	12	10	13	14	9	37	10	10	15	22
2	33	3	8	9	14	6	16	32	18	12	16	18
3	30	21	5	12	19	8	21	22	15	18	23	30
4	20	16	13	5	19	10	15	32	10	19	17	19
5	17	16	5	7	18	4	26	14	23	17	11	18
6	16	16	14	4	19	9	14	20	22	15	12	19
7	16	4	11	9	18	8	21	21	19	18	17	36
8	17	10	10	5	15	13	19	35	16	20	10	18
9	25	11	14	12	18	16	32	33	14	17	15	12
10	20	12	11	21	12	21	18	42	14	12	11	29
11	14	12	11	8	15	17	22	66	34	23	19	25
12	26	11	12	11	26	13	13	39	22	18	15	83
13	19	19	13	20	21	20	20	32	10	20	14	44
14	12	13	26	8	9	7	35	29	13	17	21	30
15	11	13	11	10	10	19	9	17	13	21	25	18
16	20	9	5	9	13	17	24	16	28	20	20	23
17	16	3	11	7	12	16	22	16	13	20	15	18
19	12	20	8	7	11	14	13	19	19	24	3	22
20	16	15	8	10	12	31	23	24	18	25	13	17
21	19	15	10	14	12	13	14	22	25	41	31	16
22	17	15	12	14	13	23	33	33	25	25	28	7
23	12	15	6	9	13	40	17	24	21	25	19	27
24	12	15	2	6	14	5	36	11	20	19	15	16
25	14	9	8	14	20	9	31	21	19	17	17	23
26	12	12	6	8	14	12	34	22	17	22	19	16
27	10	16	8	11	21	22	24	24	27	28	21	28
28	14	8	5	14	9	20	28	23	15	22	16	15
29	16	15	1	13	7	14	23	17	10	10	30	19
30	20		12	10	28	18	29	20	11	22	15	25
31	14		11		21		30	15		22		11

Subvert the Whole Family With Another New 73 Book

Accompanied by the applause of millions, the Amateur Radio Novice Class License Study Guide is out. Not previously published in the pages of 73, this brand new book really covers all the subjects relating not just to passing the FCC Novice exam, but to really learning all the necessary things for getting on the air.

Ham slang, FCC regulationese, simple formulas, and Novice theory are all explained and explained and explained. The book is absolutely crammed full of big, clear diagrams to explain the material step by step. After you've seen this book – and after you have really gotten your foundation in ham radio knowledge (or gotten the harmonics, XYL, or Aunt Harriet hooked on the hobby) – you'll wonder why some people just memorize answers to multiple choice questions when it is really so easy to understand the questions and answers and the theory behind them.

$3.95 buys you a softbound copy of this little gem. Buy one and convert the whole family!



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Since the particles are typically too small to observe from earth, we can only gage their intensity by the precipitation of particles into our E layer, where radio and visual sightings are made of their ignition trajectories.

If there are cyclic measurable patterns to the annual intensity of their returns, we haven't been around to observe long enough to find them.

The matter of best-time/best-path is a slightly different problem. The best-time predictions are based upon observations over the 20 years or so preceding the original 1957 appearance of the table. Within the confines of the total number of hours in a year, and the fact that no two years in a row do we end up at the same exact spot in (relative) space with the meteor shower, these times are quite accurate.

The *best-path* predictions are apparently the most subject to scorn by active year-after-year VHF meteor men. Some merely suggest you ignore these portions of the table and schedule random directions within the best time periods.

The problem may be this: The path predictions are based upon the trajectories of the particles within the meteor swarm that is called a shower. These trajectories do not change, measurably, from year to year. However, the table is based upon the *assumption* that all of the particles within the known trajectory will fall into the E layer *on their trajectory*.

Particle skipping could account for the apparent discrepancies in projected trajectories/best paths. We know the initial approach to the earth is relatively fixed. What we question is the through-the-ionosphere trajectory, which results in the placement of our ionized column, and the resulting refraction from the column that occurs.

Amateur contribution in this realm can be significant, if sufficent numbers of 2 meter meteor-shower chasers work to find the real trajectories, based upon the paths that produce the best signals during a shower where published data seems inaccurate.

... W5KHT■

Simple Digital Remote Control Circuits

Jim Ashe W1EZT

Do you want to solve a remote-control problem without getting into far-out complexity and expenses? You can easily apply a few key concepts used in sophisticated computers and industrial control systems to work out a system requiring a minimum number of parts. And if you have cost and availability problems the system can be arranged to accept almost anything of a generally appropriate nature.

For instance, if you are interested in hi-fi work a single length of common 4-wire TV control cable can be run where ever convenient to switch up to eight remote circuits. The circuits don't have to be all in the same chassis or even in the same building, if you have ambitious ideas. And the switching scheme can be extended to sixteen circuits by adding one wire to the control cable.

Short-wave listeners and ham radio operators can use the same methods for remote tuning of antennas. If you have a reactive antenna far from your ham shack you can easily tune it to any of eight frequencies by switching in capacitors or inductors; or a similar arrangement can be used to run a single transmission line out to your antenna farm where you can switch it in to any of several antennas. Let's look into an idea very popular in computer science.

Digital coding

When we are switching circuits, we do not usually expect the switching operation to take place by gradual degrees. We want the switch hard *on* or hard *off*, full in or full out. A capacitor is an active part of the circuit or else hopefully does not influence the circuit at all. Sometimes we use continuous remote control tuning systems or gain-control arrangements, but these require elaborate provisions to guarantee adjustment to the proper setting. A system will be very much simpler if the only adjustments are yes-no, on-off switching operations.

There is a number system that works in this way, and we can hold this system against our switching circuit requirements to discover they correspond exactly. We call this the binary number system. See **Fig. 1.** From right-to-left the first digit is either a zero or a one, the second a zero or a two-value, the third a zero or a four-value, and so on. In using this system we remember

16 VALUE	8 VALUE	4 VALUE	2 VALUE	1 VALUE	DECIMAL EQUIVALENT
0	0	0	0	0	= 0
0	0	0	0	1	= 1
0	0	0	1	0	= 2
0	0	0	1	1	= 3
.	.	.	.	.	
.	.	.	.	.	
0	0	1	0	1	= 5
.	.	.	.	.	
.	.	.	.	.	
.	.	.	.	.	
.	.	.	.	.	
1	1	1	1	1	= 31

Fig. 1. How binary place values add up to decimal numbers.

the place values and include them if there is a one in the place, or leave them out if there is not. Binary 101, for example, comes out four plus no two plus one, or five.

Now, when we design our switching system, perhaps we are not too certain which of various possibilities is best. Maybe we think we will switch in a different component for each setting required, as in **Fig. 2.** Is this the simplest arrangement we could find? Probably not, because each component is used only once.

And then we think about adding components one by one, using a switch with a wide sliding contact. See **Fig. 3.** This is very

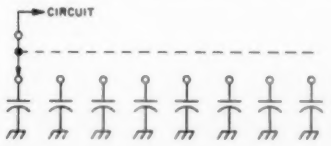

Fig. 2. Eight separate capacitors are needed to make up eight values of capacitance in this simple switching circuit.

like using a variable component such as a tuning capacitor, so we see this scheme has the blessing of antiquity, but it turns out we save no parts at all and add the requirement of a rather special switch. Now let's look at Fig. 4, and see what we can do with the binary number system.

Here we have a set of unequally sized values, and a circuit that can switch in none, a few, or all of them according to the definite schedule of the binary number system. Since there are only three components corresponding to three digits of a binary number, we require only three wires to control the switching, plus a ground return lead. This is how we can get eight assorted values using three leads and three relays.

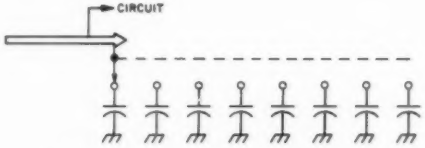

Fig. 3. If we use a continuous shorting switch, we still need eight capacitors, and the switch will cost more than an ordinary selector switch.

If we want to do remote through-switching, as in the case of several antennas fed by one transmission line, or when we want to carry out several remote control functions, the picture is a bit more complex. See Fig. 11.

The chain of relays decodes the incoming control signal to determine which of various possible paths is complete. If you have relays with several sets of contacts you can get by with only three relays or you can series and parallel windings to make up the equivalent of multiple-contact relays as required

For remote-control work we can arrange the relays in a simpler way, so that each set of one, two, or three relays will complete a circuit only when its number is fed into the control line. I've worked this out in Fig. 10.

You can design systems capable of many more switching or control operations by adding one or two additional wires. I am discussing an eight-value system fed by a 4-wire cable simply because it works out well and is elaborate enough for most purposes. If you want to make something more complex you can try using a multi-wire cable or, if you have an *rf* application the coax outer conductor can serve as a ground return.

System input switching

How do we set up a system that will apply a voltage, or else no voltage, to each of the control wires according to the pattern of binary arithmetic? There are three ways we can do this.

The simplest is a switch in each line, and if the switch is on, there is voltage applied to the line. We label the switches 1W, 2W and 4W, and the W stands for the term "weight" to remind us we have an additive switching system. If we want a No. 5 control operation at the other end of the circuit we turn on the 1W and the 4W switches. Going to a No. 6 control operation we turn off the 1W switch and turn on the 2W switch. I have diagrammed this in Fig. 4 and Fig. 5.

Another way we can apply the correct voltages to the control wires is a several-pole several-position rotary switch. There is a pole for each control wire and a position for each control setting as in Fig. 6. Rotating the switch feeds the power supply voltage to the appropriate wires in sequence for each control position to convert our front-panel numbers or labels into a binary coded voltage applied to the control cable.

This arrangement is excellent for small systems but it becomes impractical for anything more elaborate than our three-leads-and-return system. We need a three-pole eight-position switch here, and such a switch is probably easy to find.

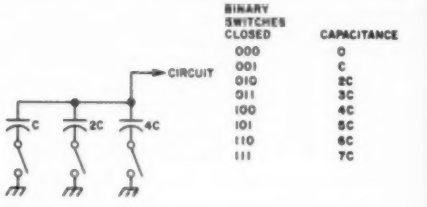

Fig. 4. Switching capacitors according to the pattern of the binary number system enables us to get eight values of capacitance from three capacitors.

Adding one more control line brings us to finding a four-pole sixteen-position switch, and a five-pole thirty-two position switch would be expensive and very hard to locate. But there is still another way we can do our switching, with a single-pole switch for any number of conductors.

The three-wire and return system is diagrammed in Fig. 7. Why have I added the semiconductor diodes? Because without them the circuit would be unable to dis-

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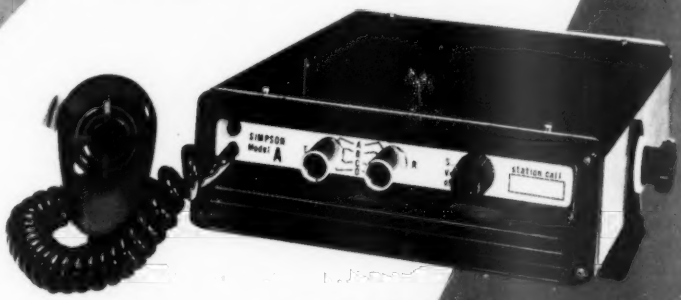

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criminate between certain control settings. Let's imagine diode D1 is shorted, and we are turning the switch through its positions.

At position 0 no supply voltages are applied anywhere. Going to position 1 relay 1W is energized as it should be, but the voltage also passes back through shorted diode D1. From there it goes forward through D2 to energize relay 2W. We pull out D1 and replace it with a good diode, and in the 1 position only relay 1W can be energized. Looking again at **Fig. 7** we see that if D7 were shorted a 1 input setting would energize all three relays for a no. 7 control operation.

Adding more available switching positions is merely a matter of sketching out this illustration on a roomy piece of paper and adding lines and diodes. The next line without a diode would be the 8W line, and all the others would get diodes. Reverse diode polarity for a negative supply voltage.

You can use surplus junction diodes in this application, and a simple forward-current/reverse-voltage test will be adequate. These cheap diodes at a penny or a nickel apiece will do well here if you are careful to check them first, since this service is extremely easy on the diodes. A special case I'll touch on later is when you are working with antenna systems that may be struck by lightning. Other diode failure mechanisms are case leakage and poisoning from contaminants already inside the case. If you use surplus diodes do not let your suspicions lapse after a few weeks.

When you are designing your remote switching system, remember your power supply may have to energize several relays for indefinitely long times. Test it at 35% over anticipated maximum load current for a day or two, and if it passes, it will be reliable in normal operation.

In choosing supply voltage allow for voltage losses along the remote control line.

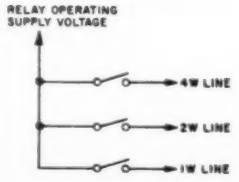

Fig. 5. The simplest way to feed a binary coded control signal into our control cable is to use separate switches and do the adding in our heads.

The relay sees supply voltage less all IR drops along the line, and these depend upon current. Each lead of the 4-wire control line will run about 0.3 ohms per hundred feet for copper, 3 ohms per hundred feet for steel wire, in the No. 20 size. And voltage drop along the ground return lead must be estimated on the assumption this lead is carrying *all* return currents the circuit can develop.

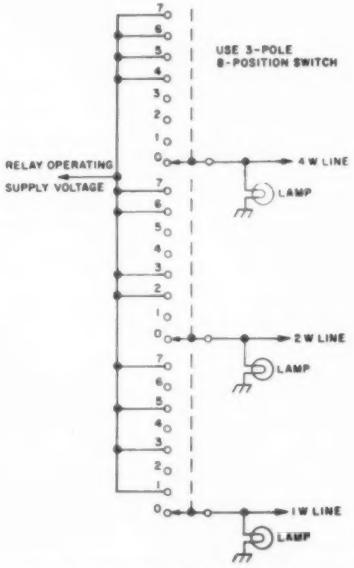

Fig. 6. We will probably need a three wafer rotary switch for this circuit, which will code the correct voltages into the control cable for each setting. Pilot lamps offer binary readout of the signal applied to the system.

Control cable installation

A few quick passes with a tape measure will give you a good indication of how much control cable is needed for your remote control installation. If the cable could be stretched I'd recommend an eyeball estimate, but in my experience when you come out short you have to splice. Measure, add five or ten percent to the results, and obtain that much cable.

Put paper or cloth tape around the cable wherever you staple it down so that sharp metal edges cannot penetrate the insulation and short wires. There is a lot of TV hardware available for getting the cable through walls and windows, and outlets and other fittings are available from electronics suppliers.

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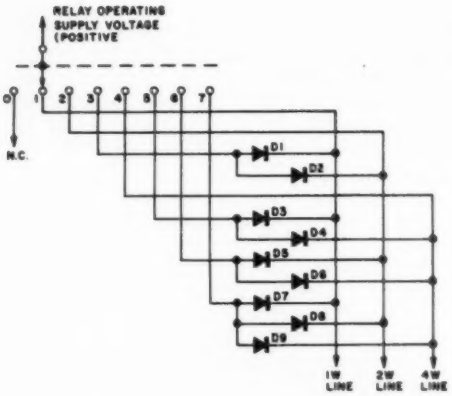

Fig. 7. A more complex circuit enables us to use a simpler switch. This is the way to do it for large systems.

Use mating connectors at control points. It is very inconvenient to have the relay box wired in place when you want to get it over to the bench for alterations or servicing. There should be several inches of slack between the cable and the box for convenience and to eliminate strain on the connector.

The control cable has no business next to power circuits. Keep it and its connectors well away from power outlets and avoid arrangements such that some interconnection could develop. There is a special problem which may appear in very long outdoor cable runs, such as to a remotely controlled antenna.

Good antenna design resembles good lightning rod design. Use correct precautions in bringing control and antenna leads into your house, and there is another protective step you can take to save diodes. See Fig. 8.

When lightning strikes nearby there may be a fierce sweeping magnetic field developed. Good design minimizes the amount of energy this couples into your remote control system. See Fig. 9. The wires to the tower are twisted around each other to minimize open space between the conductors, and so that induced currents in different parts of the system flow in opposite directions and average to near zero.

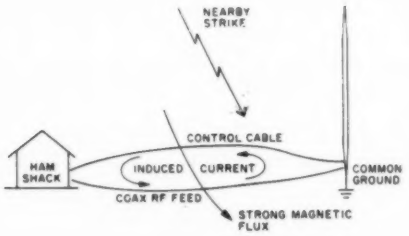

Fig. 8. Strong magnetic flux from a nearby earth strike can damage diodes by inducing large voltages if cables form a sizable open loop.

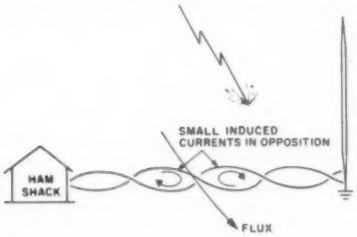

Fig. 9. Induced power is made small and averages to near zero if we twist the cables around each other a few times. Not recommend for twin-lead carrying rf.

A coaxial *rf* feed to the antenna is ideal for this kind of system because the *rf* is entirely inside the cable. Additional control wiring outside the coax does not upset its function. If you built a similar arrangement using twinlead, its radio performance would be completely ruined by coupling of *rf* into the control system wiring.

Relay switching

Choosing relays is much easier than finding transistors for some specific applications. Relays are uncritical, and you can parallel relays for more working contacts or series them to make up an equivalent higher-voltage winding. You can use series resistances too, if the supply voltage is high. When you are working with old or surplus relays clean the contacts carefully, and finish up with some paper to wipe out any abrasive that may remain in the assembly. Audio relays can be very small but *rf* relays will normally be large and require appreciable power. If both sides of the contact assembly are hot they must be insulated from the relay frame and from whatever metal the relay is mounted on or in. For audio applications remember the lines to the relay winding will carry noise very near the signal switching contacts and there may be enough crossover through small capacitances to high-impedance low-level signal lines to cause noise problems. It will probably be trouble with 60 Hz hum interference. This tells us low-impedance lines are preferable

since they will usually pick up less noise in long runs.

Let's suppose we have a three-leads-and-return system to several well-separated control points. We want to complete a circuit at a particular one of them only when we have applied a one or a five control to the line. To do this we must have three relays at the control point. See **Fig. 10.**

The key is in the relay contact connections and in the general similarity between a one and a five control signal from the circuit's viewpoint. First let's suppose we have fed a one into the control circuit.

Relay 1W is closed because that line is energized. This completes this circuit . . . but wait! Why are relays 2W and 4W needed to get a No. 1 connection? Because the 1W relay is energized for 3, 5, and 7 inputs as well as a 1 input. So relays 2W and 4W must allow the 1 circuit to be completed only if the 2 W and 4W lines are not energized. This is a decoding problem.

Now let's look at the 5-circuit. This must be complete only if we feed a five to the input. At this setting the 4W and 1W lines are

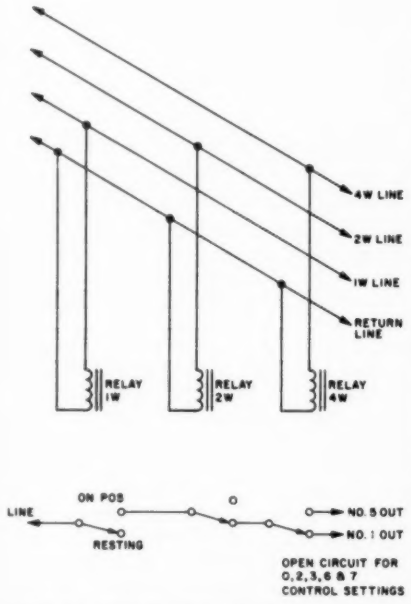

Fig. 10. Here is one station of an elaborate remote switching system. It completes a circuit when the control setting is either 1 or 5. Use this for reference in working out arrangements to function at other control settings.

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energized and the 2W line is not. We wire the normally-open contacts from relays 1W and 4W together in series and add a normally-closed contact from relay 2W. In this example the two circuit conditions could share all three relays and some common contacts. You can work out other arrangements according to your individual requirements.

Since the individual relays do not interact with each other, several relays can be operated electrically in parallel but physically far apart.

A switching problem similar to this one and simpler in some ways is connecting several antennas to one transmission line or several branches to a long audio line. Here you simply arrange the 1W, 2W and 4W relay contacts to form barriers across all possible circuits except one. See **Fig. 11**, and it may seem a bit surprising to discover the least-weight 1W relay carries the most contacts.

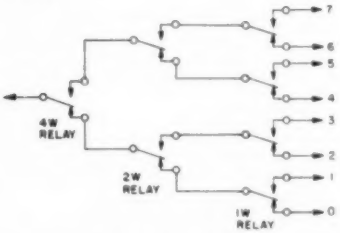

Fig. 11. Three relays can switch a line to any of eight other lines. Note the 1W relay carries the most contacts.

Finally, we have the antenna tuning problem again. There are two general ways to tune reactive antennas such as a very large loop or an off-resonance tower. These are additional inductance or additional capacitance. Let's suppose we have an antenna which needs some additional parallel capacitance. See **Fig. 12.**

There are four capacitors. One is always in the circuit, and it gets us into the right ballpark by tuning the antenna to the highest required frequency. Then by experiment we discover what capacitance tunes the antenna to the lowest required frequency. Let's say this works out to 410 pF max to 380 pF min. over a range of 3.5 to 4.0 MHz.

Our fixed capacitor will have to be 380 pF and we will make up the other 30 pF in seven steps, 4 plus 2 plus 1. One seventh of

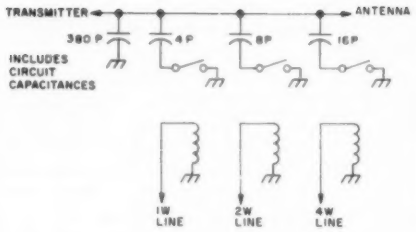

Fig. 12. Remotely located at the base of an antenna tower, this system will switch in parallel capacitances for tuning the antenna to any of eight frequencies over a narrow band.

30 pF is about 4 pF, a very small capacitance. Wiring capacitance could be important but we can absorb this in design and adjustments. It will make up part of the 380 pF.

Now, we see the three capacitors we want to switch in are 4, 8, and 16 pF, and a fudge factor we will throw in by trimming after construction. Since we can easily make up these capacitances from metal plates and surplus hardware the antenna tuning system will not be expensive.

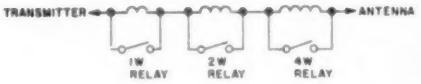

Fig. 13. Here is an arrangement, similar to that of Fig. 12, for inductive tuning. Both sides of the relay contacts carry heavy rf currents and must be well insulated.

We assemble this circuit using whatever we can find in our junkboxes or stores. After completion we make final adjustments with an SWR bridge, at the frequencies tuned by the 4, 8, and 16 pF capacitors independently. And then we go back and try the intermediate frequencies to optimize the zeroed-in points.

A similar circuit with relay contacts in series with the antenna current rather than in parallel with it, works for introducing graded inductances into the circuit. We short those we do not want operative. Toroidal inductors are good here, since if they are at least one coil thickness apart there is inappreciable interaction between them. If you use solenoidal coils they should be separated by a diameter or more. Calculation of sizes and adjustment of the system go in the same way as the parallel capacitance case.

. . . Jim Ashe

HOW TO BE AN AMATEUR

John Campbell W2ZGU

While John was never very active as an amateur (he let his call lapse now and then), he was enthusiastic and a builder of many and varied gadgets. He was best known for his remarkable editorials in *Analog*, previously known as *Astounding Science Fiction Magazine*. John had a different slant on everything and it was a rare privilege for me to get together with him now and then for a lunch. Those of you who have read his editorials know what I'm talking about – those who have missed them have missed one of the more enjoyable experiences life has offered.

In the first issue of 73 we had an interesting article by John. Perhaps it is time to reprint it.

The good amateur – that is, the amateur who is useful in causing progress in the field he's in – has certain basic characteristics that are the same, no matter what that field may be. He may be an amateur in radio, electronics, chemistry, painting, or anything else; to be useful he must have a certain basic code – the Code of the Amateur.

A Good Amateur is . . .

1. Ignorant.
2. Egocentric.
3. Impractical.
4. Disrespectful of authority.
5. Materialistic, or pragmatic – not idealistic-theoretical.
6. Inconsistent.
7. Illogical.
8. Discontented.
9. Aggressive.
10. Unfair.

Every one of those characteristics, you no doubt noticed, is generally considered anti-social; he's egocentric, and enjoys his own company, his own work, more than the best chitchat of the cocktail-party group that is, of course, the highest ideal of the extrovert-social type. The Amateur is antisocial, in that he *likes* – actually *enjoys!* – thinking! He actually prefers using his brains to flapping his jaw; he normally thinks *before* opening his mouth. This is, of course, antisocial, because it imposes the necessity of thinking on those around him – which naturally makes them very uncomfortable. They're not used to it.

The Amateur is Ignorant; this is necessary, because he wants to learn – and you can't learn something you already know. The thing that makes an amateur's ignorance so useful, however, is that you can't learn if you already *think* you know, either. The old line about "It ain't all them things you don't know that causes trouble; it's them things you do know that ain't so." The Amateur is ignorant, and escapes that trouble. Throughout history, amateurs have been lousing

things up for professionals by doing what everyone who knew anything about the business knew was impossible . . . until the amateur, who didn't know any better, did it.

Like "Mad Anthony Wayne," during the Revolution – the amateur soldier. He attacked a perfectly impregnable British position. Anyone with military knowledge knew it was impregnable, because there were sheer, 300-foot cliffs protecting it on three sides, making attack from those directions impossible. "Mad Anthony," not knowing any better, lead his men up the Palisades at night, and cleaned out the British.

The Amateur has to be Egocentric. That is, nobody's going to pay him for all the hard work he does, so he'd better enjoy what he's doing because it pleases *him*. All his work will, 99.99% of the time, yield nothing but discarded materials, and passed time. In the course of ten years, an Amateur may spend $10,000 on his hobby, wind up with $2 worth of junk, and nothing else . . . except the self-satisfying fun he had doing it.

That, by the way, is one of the ways in which the Amateur is impractical and unfair. Amateurs happily tackle a research project that has one chance in 10,000 of succeeding, spend ten years and $10,000 on it. Obviously, this is economically unsound; no professional research organization would consider so risky a venture; it would be economic suicide. For one thing, the Amateur in question may be a $100,000-a-year executive in a major corporation; he's worth that to his company, because of the extremely high level of judgment he has. That high ability to judge, to select between alternatives, is being applied in his hobby – the $10,000 worth of material he invests in his hobby is nothing compared to the $1,000,000 worth of highly trained judgment he's also investing!

But the Amateur can, of course, charge off all those expenses, all the investment of time, effort, energy and money, to "Entertainment." It's a heads-I-win-tails-you-lose setup; if his research does not yield the desired result – it still yields ten years of fine entertainment.

This is very unfair competition from the viewpoint of the professional, who has to charge all the time, effort, and money invested to "expenses" – he can't call it "entertainment." The Amateur's research project, in other words, can never wind up bankrupt – in the red – a net loss. The fun of doing it, not the result, is the main product; any workable result is, then, pure gravy – a bonus over and above the call of entertainment.

Time and time again in the history of Science, the great breakthroughs have been made by amateurs: the great breakthroughs always will, for all time to come, be made by amateurs. The reason's simple: a true Amateur can tackle a problem with no reasonable hope of success, and not suffer any loss. No professional can do so.

The essence of a breakthrough discovery, however, is that *it could not have been predicted* on the basis of previously known facts. Pasteur, a chemist, not a biologist or doctor, achieved the great breakthrough in medical-biological science – the discovery of germ disease. It could not have been predicted beforehand. No one could have, a year previously, reasoned that investigation of microscopic life-forms would be the way to solve the problem of disease.

Put it this way: Today, in the race for space, we need something a darned sight better than rockets. Rockets can never be developed to an economically practical method of commercial use of space; chemical-fueled rockets must consume tons of starting fuel for every pound of payload out into space. Nuclear, or photon rockets can never be used to take off from earth – the exhaust from such a rocket motor necessarily has an appalling energy intensity. It would slag down half a county behind it as it thrust itself up into space.

We *must* develop either an anti-gravity device, or a true space-drive – some kind of a device that can sink its claws into the structure of empty space, and climb like a squirrel going up a tree.

No professional will ever achieve such a breakthrough invention; if Dr. Quiddius Q. Quidnunk of the Research & Development division of the Brontosauric Manufacturing Company does turn up as the discoverer – you can bet he did it as a hobby-amateur project, not in his official capacity as an

R&D man for Brontosauric.

The reason's easy to see. Given: We want an anti-gravity device. It's worth $500,000,000 to the comapny that gets it. With a prize that size dangling, surely it pays to do research on it!

It would indeed . . . if someone could suggest someplace to start!

In 1935, Dr. Robert A. Millikan, one of the world's top atomic physicists, said it would be "250 years, at least" before we could release atomic energy. He was wrong by 243 years. What he meant was that as of 1925, no one had the slightest idea where to start looking for the answer! In 1940, they did know where to start; uranium-235 was the starting point. It took only two years to get an engineering device, once that was known.

The Amateur, because it's "entertainment," can start looking for the place-to-start; he doesn't have to wait for it to be discovered before launching his research.

The great Bell Laboratories had, of course, been looking for some way of amplifying electrical signals for years before that kid, Lee De Forest, came up with the triode vacuum tube. The transcontinental telephone line was impossible until an amplifier was invented. Bell needed one, knew they needed one, and couldn't imagine where to start looking for one, of course.

There's a lot of government-sponsored research being done today; Commissions, Authorities, Departments and Divisions of the government set up boards, committees, and agencies to assign research projects.

Let's imagine that government-sponsored research had been common throughout the history of the United States, and consider the probability that a government agency would have made the actually-correct assignment. The boards must, of course, act logically, with careful consideration of the opinions of the authorities in the field. Project assignments must be allotted fairly, logically, on the basis of the best available theoretical knowledge.

Would they, then, have assigned:

1. Development of a rapid, long-distance communication technique to a second-rank portrait painter by the name of Sam Morse?

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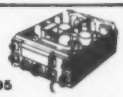

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2. Development of a technique for voice communication to an obscure teacher of the deaf in the Boston area, Alex Bell?

3. Development of a heavier-than-air flying machine to a two-man bicycle shop in Ohio?

Other projects would not have been assigned at all, by a committee which, not being amateur, was logical, had respect for authorities in the field, and acted on theoretical grounds. They would never, for instance, have assigned the project of developing an electric lighting system to anybody; it was proven mathematically by top physicists of the time, that such things could never be practical. The reason is one any radio ham can understand – it was "known" that the maximum energy-transfer in an electrical circuit was achieved when the resistance of the generator equaled the resistance of the load. Therefore, in an electric lighting system, one-half of the energy would be dissipated in the generator, and only half would be available for lighting. This made the maximum possible efficiency 50% – but worse, it meant that, for any sizable electric system, a tremendous amount of heat would be generated in the dynamo. Large machines would be impossible, because they would simply melt themselves into scrap.

It's most certainly true that if modern generators weren't 99% efficient, they would melt themselves into scrap. It's hard enough to get rid of 1% of ten megawatts, or 100 megawatts of heat; if the learned authorities had been properly respected by Edison, he'd have recognized the futility of inventing incandescent lights.

The Amateur can, of course, expect all kinds of trouble when he *does* achieve something. The Learned Authorities assure him he's a crackpot; not infrequently the said Learned Authorities have the police arrest him to protect the public from his phony racket. Alexander Graham Bell was arrested for trying to sell stock in his telephone company, I understand. Louis Pasteur threw his future into jeopardy when he first used his anti-rabies treatment on some Russians who had been bitten by rabid wolves. No M.D. would give them the treatment; Pasteur was not an M.D. and risked trial for murder if one of his patients died. (Things are different now; under modern laws, Pasteur would have been jailed for curing the dying patients. Now it's illegal to try to cure someone, successfully or not, unless you're a licensed M.D.)

It's interesting to realize that three of the most famous criminals in history were, technically, amateurs. Jesus, Galileo, and George Washington were all, technically, criminals and amateurs. (Jesus defied the theocratic laws of the Jewish government; Galileo taught, without being properly accredited by the orthodoxy of his time, and Washington was, of course, defying the British Crown, as an amateur statesman-general. Meanwhile, Ben Franklin, amateur diplomat, was doing a bang-up job in France, to England's most acute annoyance.)

A considerable amount of aggressive determination is, therefore, a *sine-qua-non* requirement for the Good Amateur. He can expect a battle when he does achieve his goal.

Obviously, he's achieved it illogically. If it could be achieved logically, from the accepted facts, professionals would have beaten him to it. The criminal-amateur must have achieved the goal by some illogical, unfair step. ("Unfair," when looked at closely, means "You did it by a method I didn't consider proper!" Obviously, if the professional had considered the method proper, and had tried it, he'd have beaten the amateur to the punch.)

Go back and check over the ten points that make for the Good Amateur, and you'll see why they are necessary. If he weren't discontented, of course, he wouldn't be trying to do something that "can't be done," or trying to do better a thing that can be done.

But the Good Amateur must be practical in one respect; he must not seek to compete with the professional on any fair, Even-Steven basis. He must always seek some underhanded, unfair trick. The amateur must not waste his time-effort-money on trying to do what the professional lab can do a thousand times better, faster, and easier. Don't build your own voltmeter . . . unless you want to learn, by actual building, what a

voltmeter really is. Then, of course, you're really building your own knowledge-understanding, not a voltmeter. You simply can't wind as perfect a moving coil, or make as precise and perfectly aligned bearings, as a huge production machine-complex can; it's inefficient to try. Don't try to make your own transistors. Don't try to solve any problem that the professional research labs are working on *in the way the pro labs are trying.*

The pro labs are now, just as an example, trying to find a better method of long-distance communication. They've sent up that Echo sateloon reflector; they've investigated troposphere scatter, they've explored single sideband, pulse code modulation, pulse time modulation, a thousand variations. Don't compete; you'd be "fighting fair," and would be sure to lose.

Be unfair; try finding out how telepathy works. Solve that one, and you'll junk all the multi-megabuck projects the pros have invested in. No pro researcher can tackle the problem, because, of course, it's one of those things that you can't tell where to start working.

Legend has it that Alexander cracked the Gordian Knot problem by slashing through the knot with his sword. Now there's an interesting thing about this; any amateur knows that it's a damn sight easier to untangle a snarl of wire that has only two ends than one that's been cut in two and has about 50 ends. The two-ended knot you can, at least, start *here*, and know that, by simply keeping at it, you'll necessarily come out *there*.

Any pro lab can beat you six ways from zero on that sort of problem; they've got electronic computers, large staffs, and megabucks to grind away at the starting end, and follow it through.

The one that stops the pros, though, is the Gordon Knot after Alexander slashed through. It's got 100 ends, none of which can lead to "the" end.

The real fundamental research scientist is a Good Amateur; that's why government research programs simply can't do a decent job of supporting true basic research. To be truly basic research, the project must *not* know where it's going to wind up, it must *not* not how it's going to get there, and must *not* be logically deductible from known factors.

The "tunnel diode" was the result of a Good Amateur type experiment; the result obtained not only could not have been predicted by previous knowledge – previous knowledge specifically predicted that it couldn't happen! Since it is theoretically impossible for electrons to travel at the speed of light, it could be shown that, theoretically, no electronic mechanism can have signal-transit times as short as light-speed would make possible.

Happily thumbing its miniscule nose at theory, the tunnel diode is an electronic device with signal-transit velocity equal to light-speed.

It also violates all proper transistor solid-state semi-conductor theoretical approaches. To be any good, a solid-state semi-conductor must have very, *very* VERY little impurity – "doping" – in it. The tunnel diode results from doping the germanium or silicon like crazy. Do the wrong thing – that's what works!

In the early days, the hams got shortwave radio going by doing wrong things like taking the carefully manufactured tubes right out of their carefully cemented-on bases, and soldering the leads directly into their circuits.

The real motto of the amateur must be, "Never give a pro an even break! Be unfair!"

To be a Good Amateur, don't compete with the pros – do what no pro would ever think of doing. And be egocentric – whatever project you pick, pick it because you like it, not because somebody says it is your duty. That way, you're playing the heads-I-win-tails-you-lose game; no matter whether your project succeeds or not, you'll have had a hell of a lot of fun! Tackle the absolutely impractical projects – the ones where you'll have no pro competition. And always disregard Authorities; of course they're sure it's impossible. If they weren't they'd have gone after it themselves. A thing can be economically impossible for professional research – and be completely practical for the happy little amateur. Lord knows climbing Mt. Everest is economically impossible in any profit-and-loss sense. What possible financial

profit can be made up there?

And the amateur doesn't have to explain *why* his gadget works; to hell with theory! Be pragmatic; simply use it. Show *that* it works, and let the red-hot theoreticians worry about *why* if they want to.

Also, be ready and willing to be completely inconsistent at any moment. If, one day, while working on a new idea for a two-meter half-kilowatt rig, that you've told everybody is going to be a two-meter transmitter, said unit should suddenly start rising off the bench and floating up toward the ceiling – be inconsistent! Say, "I'm building an anti-gravity machine," and if somebody protests that you said it was a radio transmitter – why, point out that it obviously *is* an anti-gravity machine, so, obviously, that's what you were actually building. That's common sense, isn't it? Why should you care that it consumes a full gallon, and peeps out with only 2 watts on 2? It floats, doesn't it?

Always be willing to change your project if something better slugs you along the way. Like George Baekland; he was trying to synthesize some complex organic chemical, when the chemicals in his apparatus clabbered, turned into goo, and finally set into a solid mess. Efforts to clean his apparatus of the stuff proved totally futile; he couldn't dissolve the mess in anything he could find; it just sat there sneering at all his high-power solvents.

Of course, other chemists had had similar sad accidents, and had had to throw away not only their chemicals, but their apparatus as well. Baekland was by no means the first to wind up with a mess that nothing known to chemistry would remove. "I," he decided, "am *not* synthesizing 1, 2-alpha, betaomicron after all. I'm synthesizing something as useful as the fabled Universal Solvent – the Universal Insoluble! Since I can't get rid of the damn stuff . . . there must be somebody that wants a material that stubborn, so I'll sell it." With that inconsistency of approach, things were easy. It was a snap to remove the apparatus from the mass of Bakelite – the glass would break, or dissolve in hydrofluoric acid.

Remember, too, that Bell was working to invent the "musical telegraph" – what we now know as carrier-frequency telegraphy – when he got the wrong result. He was a Good Amateur, and immediately decided he was inventing a telephone instead of a musical telegraph.

There are lots of patents to be gained by seeing how *bad* a job you can do. The body-capacitance burglar-alarm, for instance, is the worst possible approach to a stable VFO exaggerated and patented. Almost anything that is *extremely* one thing or another has some useful application. *Vide* Bakelite. Transistors tend to be very temperature-sensitive; they make wonderful high-sensitivity thermometers because of that. The R-C oscillators such as the multivibrator are horribly unstable . . . which makes them wonderfully useful as frequency multipliers and/or dividers. Being inherently unstable, they'll happily lock in with the frequency of any nearby oscillator.

Each of the characteristics I've listed as necessary to the Good Amateur is considered antisocial. Each of them is . . . in the wrong place, or wrong degree. But be inconsistent about that, too; in the right place, and right degree, each of them is tremendously useful.

I do not, for instance, recommend disrespect of Authorities when they say "The human organism does not normally operate well after being connected to a 2000 volt power supply."

It is also necessary to respect authorities in another sense; they should be respected just as you should respect rattlesnakes, mules' heels, and dynamite. They frequently have power, and should be treated accordingly.

The crackpot is the bird who not only fails to respect authority, but also fails to respect good judgment.

The Good Amateur, of course, fulfills the only usable definition of a Genius: "A Genius is a crackpot who makes money at it."

Naturally . . . because "makes money at it" is simply another way of saying "has an idea which is economically sound and workable."

Remember that almost any crackpot can *get* a patent; it takes a genius to get one *and sell it!*

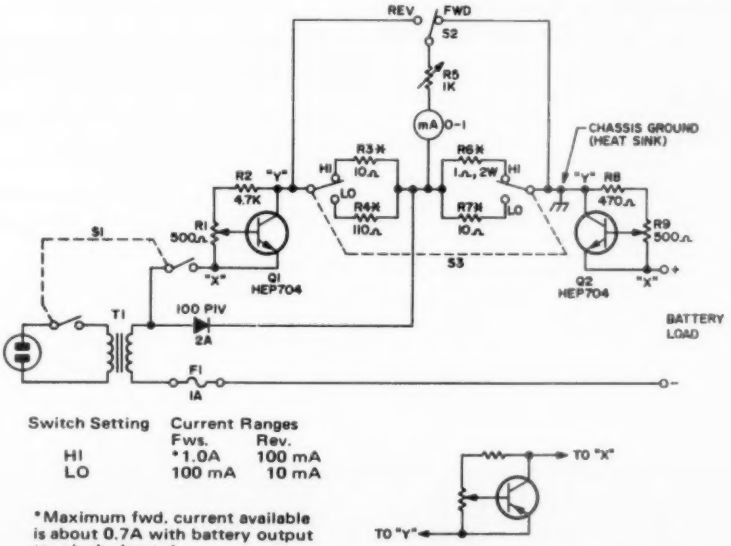
. . .W2ZGU

A Simple Reverse Current Battery Charger

F. J. Bauer, Jr. W6FPO
P.O. Box 870
Felton CA 95018

The reverse current charging technique described in an earlier issue of 73[1] is very effective but it is awkward to change the forward- and reverse-current resistor values whenever the battery type or the number of cells to be charged is changed. A resistor switching arrangement was next tried but lacked the flexibility of continuously variable controls. Also variable resistors of the required power ratings were found to be too bulky and expensive.

I next tried using manually operated current-limiting transistors for both reverse and forward current control as shown in the schematic. The control potentiometers were now low-wattage units, since they only had to handle transistor base currents. Current adjustment was also smooth and noncritical for all forward- and reverse-current values ordinarily needed to charge all types of batteries. A current metering circuit was added to permit accurate current monitoring over the range of 2–500 mA. Note that a DPST switch is used for



Switch Setting	Current Ranges Fws.	Rev.
HI	*1.0A	100 mA
LO	100 mA	10 mA

*Maximum fwd. current available is about 0.7A with battery output terminals shorted.

Fig. 1. Schematic.

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MINIATURE SIZE: 1½" X 5/8" X 1"
20 dB GAIN • LESS THAN 3 dB N.F.

Single stage, R.F. Protected dual-gate MOSFET. 4 miniature trimmers for tuning and impedance matching. Aluminum case with feed-thru solder terminals. Provision for manual gain control or AGC. Tuned to the frequency of your choice from 135 MHz to 250 MHz with 2–4 MHz bandwidth. Supplied with mounting kit for installing inside or outside your receiver.

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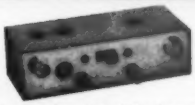

The Model 202 uses 2 of T.I.'s super low noise J-FETS in our special circuit board design which gives a minimum of 20 dB power gain at 450 MHz. Stability is such that you can have mismatched loads without it oscillating and you can retune (using the capped openings in the case) over a 15–20 MHz range simply by peaking for maximum signal. Available tuned to the frequency of your choice between 300–475 MHz. 4-3/8" X 1-7/8" X 1-3/8" aluminum case with BNC receptacles and power switch.

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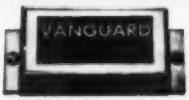
SUPER LOW NOISE: LESS THAN 2 dB N.F.
POWER GAIN: 24 dB @ 150 MHz.
MINIATURE SIZE: 1½ X 5/8" X 1"



Features a super low noise J-FET rated by T.I. as typically 1.2 dB N.F. @ 150 MHz (transistor data curves supplied with unit) and guaranteed by our lab to give under 2 dB actual N.F. in our circuit. Transistor is mounted in a socket with gold plated contacts. 4 precision trimmers make possible tuning for optimum desired results over a wide range of conditions. We supply it tuned for minimum noise figure across 50 ohms input and output resistance. Fully shielded in aluminum case with feed-thru solder terminals. Supplied with mounting kit for installing inside or outside your receiver. Tuned to the frequency of your choice from 135 MHz to 250 MHz with approximately 2–4 MHz bandwidth.

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All of our pre-amps are available with a certified test report stating the actual gain and noise figure as obtained on Hewlett-Packard test equipment and supplied with a nomograph that will give you the sensitivity you can expect with a given noise figure and receiver bandwidth.

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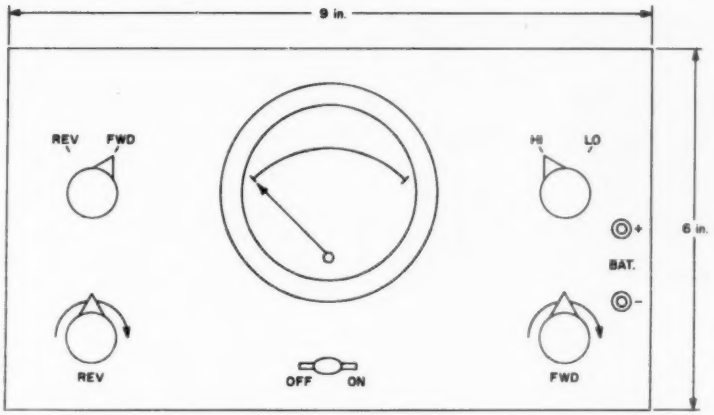

Fig. 2. Panel Layout.

on-off. This is so the batteries will not accidentally discharge through the reverse-current transistor and transformer secondary winding if the charger should be turned off without first disconnecting the batteries.

Construction of the unit presents no problem since layout and lead lengths are not critical. Panel layout of the original model is shown in Fig. 2. The forward-current transistor (Q2) is bolted directly to the chassis which acts as a heatsink. For this reason both charger output terminals are above chassis potential and must be insulated from the panel and chassis. The reverse-current transistor (Q1) is merely insulated from the chassis by insulated shoulder washers and requires no heatsink. It never has to dissipate more than 1W under any operating conditions, which is far below the dissipation ratings of the 2N3055.

If you happen to have equivalent PNP silicon transistors of the proper ratings, they may be used in place of the NPN types shown by just reversing the transistor and its voltage divider connections as shown in the insert on the schematic. Do not attempt to substitute germanium power transistors for the silicon types, however; germanium power transistors are quite temperature sensitive and will require constant readjustment with the simple circuit used in this charger.

The metering circuit uses a 1 mA meter in a simple current measuring circuit. If the recommended resistors shown are used, no calibration will be required other than adjusting the meter series resistor (R5) on the lowest current range. This is most readily accomplished by using another milliammeter in series with the 10 mA shunt and adjusting R5 for full scale with 10 mA flowing through the circuit.

In case you are wondering about the odd value of shunt resistor R4, remember that the meter circuit takes about 10% of the total current. This requires that the shunt resistor be increased in value to give a true meter reading. On the higher current ranges this compensation is unnecessary since the meter current is 1% or less of the total current in the circuit.

Other meter movements may be used instead of a 0–1 mA meter. For instance, if a 50 μA meter is used, change R5 from 1 kΩ to 20 kΩ and R4 to 100Ω since meter loading on the circuit would be negligible, even on the 10 mA range.

Operating the charger is simple enough: Select the proper current range, adjust the forward current potentiometer to the desired current value, throw the switch to the reverse-current position, and adjust the reverse-current potentiometer to 10% of the forward-current value. It is a good idea

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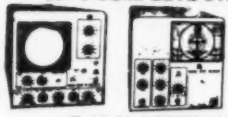

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at this point to again check the forward current and readjust as required. It will be found that the simple transistor regulators have adequate temperature stability for this application and will require little or no readjustment after warm-up.

Results have been very satisfactory when using this charger in a variety of ways including trickle charging. All battery types have responded well when recommended charging rates and duty cycles as recommended by the battery manufacturers have been adhered to. The only variable results experienced were when attempts were made to "recharge" the lowly carbon–zinc cell.[2] Apparently rejuvenation of these cells is quite dependent upon the duty cycle and age of the cell.

. . .W6FPO■

REFERENCES:

[1]Windolph, "Reverse Current Charging," 73, March 1970

[2]Lomasney, "Charging Dry Batteries," 73, December 1967

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IT'S IN THE BAG

Heh, heh, tomorrow I will sign the contract that will put everything in the bag. There will be no *possible* chance except for me to win for . . . but wait, I must start at the beginning of my epic saga.

In the seven plus years I have been a ham, my primary interest has been the VHF bands. Early in my career, I was introduced to – and addicted by pushers of – VHF QSO contests. Throughout school, I would wait not for finals, or my visit to a distant YL, but for the fateful VHF weekend in June.

Without fail, at its close, I would mutter some indiscreet phrase, and end it with "wait until September," while I was hastily packing my bags for a DX visit with . . . er . . . she is a different story altogether.

After persecuting myself through one full year of VHF QSO contests, I decided that there must be a better way, and at that moment plans began to form for a weekend DXpedition, practicing in the art of hilltopping. During that spring, my weekends were filled with flat tires, stuck cars and fogged-in mountains. By the end of that spring season on scouting jaunts, I felt I could make my move into the bigtimer's league of hilltopping. By the end of *that* contest season, a review of the results were: three lost contests *with* higher scores, two more flat tires, and a local fame for being crazy. After acquiring this fair amount of first-hand knowledge of driving up goat trails called roads, I published a concise article on "Ye Olde Fine Art of Hilltopping."*

*Connell, Patrick O. "Observations of Note by a VHF Addict", 73, Sept. 1967.

Perseverance does pay off, sometimes. By some fantastic coincidence, during the next season's first contest, everything went bad for everyone else, and I wound up with a section winner award. Gee, if I ever have had a high point, that was it.

I proceeded through another season of mountain tops and YL-less weekends which, except for the fun of it, and the reward of a good sunburn or two, accomplished nothing.

Then came the fateful year – 1968. I was ready, willing and surprisingly enough, *still* able. I looked as though I had as large a logistics base as a small army. Two meters, 220, and my new secret weapon, 6 meter SSB. While the latter was only 20 watts PEP, I thought of it as 2000. I was ready. At the site, I wound up putting on quite a show for the lookout, while I was lugging seemingly unending tons of equipment up the last couple of hundred feet of craggy mountain. Ready, four hours to go – 2, 1, five minutes – *charge*. The bands were like 20 meters; what a pileup! Wow – I can't work anybody. Shriek. On six, I worked a local who thought I was Hot Springs, Arkansas, instead of Hot Springs Mountain, San Diego section.

Have *you* ever been situated above the inversion layer? I cried while listening to locals speculate as to the manner of my demise – was it driving off the road, or suicide when I found out I didn't bring extra fuses? In such a situation, the station above the inversion layer can hear everything, but cannot break down through the layer. It is a unique experience. All I could do was to call a forlorn CQ every hour or

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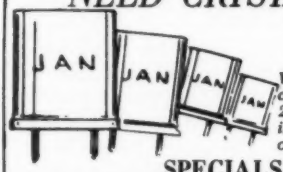

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so. I was depressed enough to try to jump off the mountain, but thought better of it and decided instead to go up and visit the YL manning the U.S. Forest Service Lookout.

This was my big break. The fates were slowly moving in my favor. At the time I had a semester left prior to obtaining an associate's degree in electronics and I was considering various fields for possible post-grad work. Beth did it.

Within weeks I was packing my foul weather gear for a winter at the University of Montana's *School of Forestry*. During the span of a matter of weeks, I changed from a Bermuda shorts-clad-Californian to what looked and felt like a set from "Sergeant Preston and the Royal Canadian Mounted Police." Well, during that winter and the following summer, which I spent working for "Uncle Smokey" in the Coeur D'Alene National Forest, I did not get much hamming in. In fact, that summer was the first in years that I missed a VHF contest. The fates were slowly working for me, but they were so doggone slow I didn't even realize it. At times I had to deliver supplies to various lookouts in my district. Something was clicking. At first, I just stood there and said something like, "Gee, you sure have a beautiful view up here" ... but *subconsciously* I was thinking, "Man, whatta site – no repeaters – beautiful." By the end of that summer, I was visiting other lookouts on my days off and was filling a pad with notes mentioning things like clear elevation, mileage to metropolitan areas, repeaters, and so forth. I was slowly gathering data for my supreme effort.

Once school started, the Forest Service sent student contract forms to the Forestry School to obtain us students of Walden for summer employment. Needless to say, I just happened to wind up with an excellent lookout position right on the Continental Divide for next summer.

It's in the bag. Spokane, Missoula, Helena and Butte are assured contacts. Beautiful. I know there might be some minor things go wrong, but it's fate. Murphy is sunk. It's in the bag.

...WB6JLC■

PASSIVE REPEATERS

. . . for amateur UHF and microwave systems.

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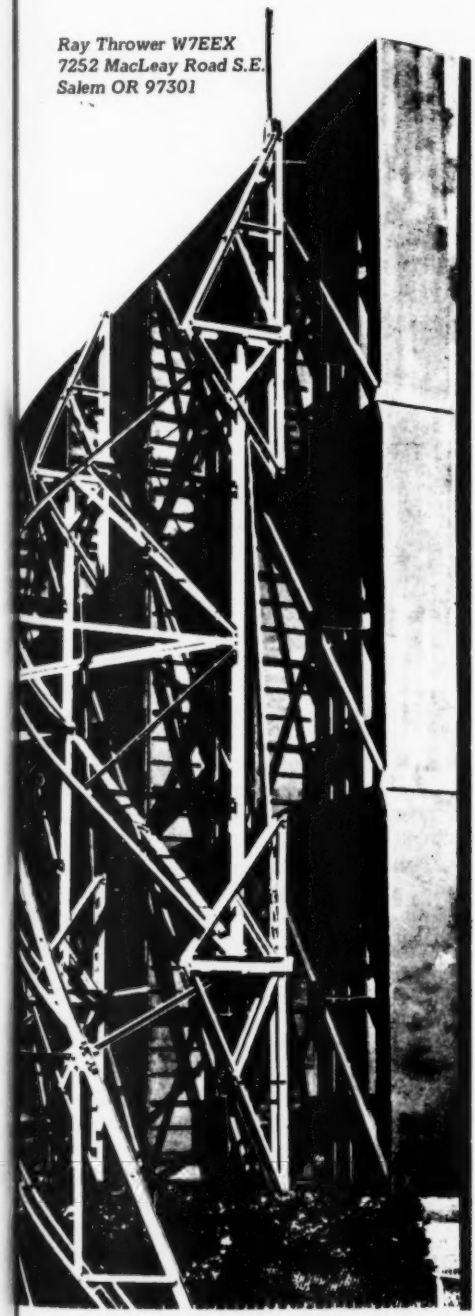

A previous article dealing with reflector techniques in ham microwave systems placed emphasis on the application of "periscope" antenna systems using passive reflectors. These were in near-field configurations. That is, where the reflector is within a few hundred feet of the exciter antenna and closely coupled with it.

Another technique of utilizing passive reflectors is in the "far field," where the passive reflector is used actually in lieu of an active repeater, many miles away, and thereby derived the name "passive repeater."

It will be the purpose of this article to show typical far field and near field passive repeater configurations and how to compute them. All calculations will be based on slide rule accuracy. In the course of the article we will also include some discussion concerning UHF and microwave propagation and antenna theory. We will also touch on a bit of communication system economics and engineering philosophy as they apply to commercial systems. These may then be extrapolated to amateur systems. There are a number of reasons for this, not the least of which is the fact that it is less expensive to install a passive repeater than an active repeater. Of course, amateur microwave gear doesn't cost anywhere near the price of commercial equipment for the commercial systems; but it can be much more difficult to construct or obtain from the amateur's point of view. This fact alone makes an optional repeater method (passive versus active) highly desirable.

Also, there is little if any maintenance associated with the passive repeater. With

no moving parts there is little chance for failure. Commercial passive repeaters have been in operation for over 15 years without ever needing maintenance.

By using passive repeaters on mountain tops, microwave system engineers can use the mountains as tall towers to get the necessary microwave path clearances. This means the active repeater stations can be placed down by existing roads and existing power lines for easy access during the winter.

Access roads and power lines are often the most expensive part of a microwave system. Access roads will cost from $1,000 per mile for simple graded trails across flat desert land to $40,000 per mile and more in forested mountain areas. Average cost is around $15,000 per mile. Add to this the cost of power lines starting at $15,000 per mile plus a minimum of about $30,000 for the radio gear for the active microwave repeater, and a commercial active microwave repeater can be a very expensive proposition. For the amateur it would be an impossible situation. In the cost figures above we have not included costs of towers, antennas, emergency power sources, buildings, etc., nor the costs and political problems involved in obtaining right-of-way easements for roads and power lines.

The passive repeater costs only a fraction of the price of the active repeater – plus the earlier mentioned fact that there are no operating or maintenance costs associated with the passive repeater. An *active* repeater will cost from $1,600 to $5,500 per year to operate and maintain, or more, depending on the complexity and accessibility of the repeater. Since the usual microwave system has a projected life span of a minimum of 15 years, operating and maintenance costs of a given repeater can exceed $50,000, which can pay for several good sized passive repeaters. By eliminating active equipment which is subject to failure, the microwave system becomes more reliable. The active stations that are necessary in the passive system have a low mean-time-to-repair due to their greater accessibility at the lower elevations, all made possible by the passive repeater on the mountain. The need for special purpose snow vehicles (for access to mountain-top active repeaters) is done away with; and perhaps most importantly, the maintenance man does not have to risk his life trying to get to a mountain top active repeater just to replace a blown fuse.

These are some of the reasons passive repeaters are used in commercial systems. They will have equal application in amateur systems.

Now, before learning how to engineer passive repeaters, let's discuss both what they are and some of the common misconceptions about them.

What is a passive repeater? Basically, it is a radio mirror. It can redirect a radio beam in much the same manner that sunlight or light from a flashlight can be redirected by a mirror. Where a very wide angle (in excess of about 135 degrees), is to be turned, better aperture efficiency is obtained by using two reflectors. (See Fig. 1.)

Actually, a passive repeater is nothing more than an extended antenna system. The passive repeater may be thought of as a section of a large parabola with the exciter parabola actually being the feed device for the giant reflector. While the giant reflector apparently is not curved, if one investigates a small section of a paraboloid, it will appear to be straight. It can be shown that a circle is actually a series of straight lines.

There is considerable confusion extant, even in engineering circles, concerning the operation of passive repeaters. One frequent question that occurs is "How can the passive repeater, a flat surface, have gain?" However, it is necessary to define "gain." In antenna system work gain is referenced to an isotropic point source which has 0 dB gain. Any change in aperture from other than a point source will result in energy being directed more in one direction than in another. The same amount of energy is available, but more of it is radiated or directed in one direction and less in another, so that along the axis of maximum radiation, there is said to be "gain" relative to the isotropic source. This direction of energy increases as the aperture (either

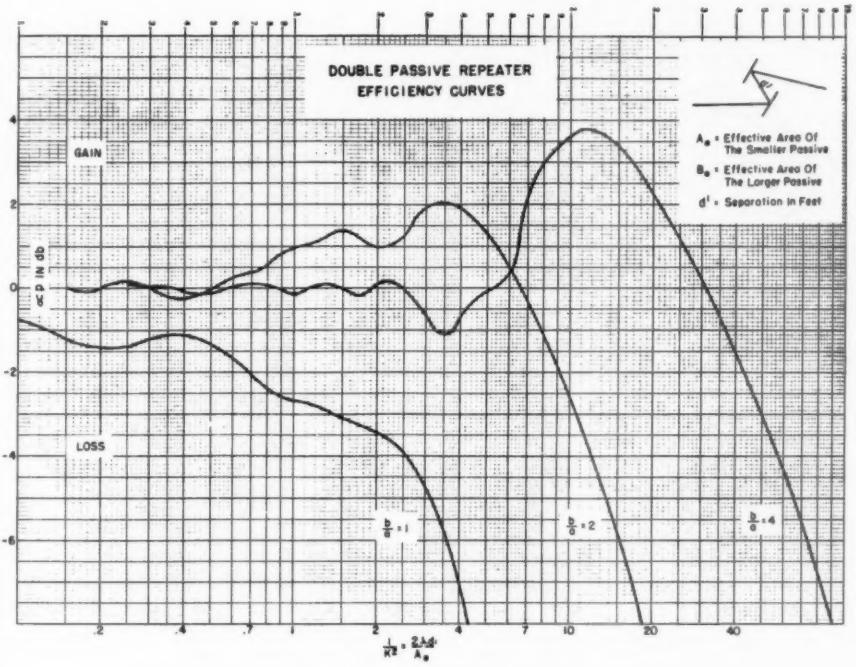

Fig. 1. Double passive efficiency.

curved or flat) increases, and therefore gain increases.

Quite probably, the difficulty most people have in understanding the aperture concept of antenna gain relates back to a common misconception about parabolic antennas. This common misconception professes that it is the focusing effect of the parabola that gives it its gain. Therefore, goes the faulty conclusion, since the passive repeater doesn't focus, how can it have gain? The truth of the matter is that it is not focusing that gives the parabola its gain. The focusing is merely a convenient means of transition from a large aperture (the dish) to a closely spaced small aperture (the feed device).

Also, if we change the position of the feed device, we simply change the amount of curvature in the reflector assembly to project the focal point at a different location. There is, then, a change in focusing, but no change in aperture gain; so gain is a function of aperture and is related to the isotropic point source – not the function of focusing. Figure 2 shows the metamorphosis of the curved, parabolic antenna, with its closely spaced feedhorn, to the plane-surfaced passive repeater. Notice that the plane-surfaced passive repeater may be thought of as a parabolic surface with an infinitely long focal length. Investigation of the method of calculating antenna gain in any antenna engineering handbook will show that only aperture and frequency are considered. Focusing does

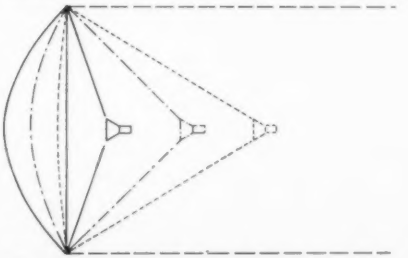

Fig. 2. Metamorphosis of parabola to plane reflector.

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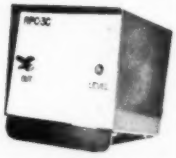

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not enter into the method of calculating antenna gain.

Another problem that frequently arises regarding the understanding of the operation of passive repeaters has to do with beam spreading. Even many engineers often wonder how the passive repeater is able to intercept enough of the half-power energy (3 dB beamwidth energy) that may have spread over a one-mile arc after coming from some 30 or more miles away. However, it is not half-power beamwidth energy that is the consideration in passive repeater work. Rather, it is Fresnel (pronounced fruh-nel) zone energy that is to be considered. (The first Fresnel zone is that region where if a reflection occurs, the reflected wave will travel 0–0.5 wavelength further than the incident wave.) Even the parabola of an active repeater is unable to intercept all of the half-power beamwidth energy, and the electronic apparatus does not mysteriously reach out and suck it in. Fresnel zone radii is the secret. There are an infinite number of Fresnel zone radii. The first is a zone where all the energy has phase characteristics that are additive. The second is reversed in phase from the first so that if both first and second zone energy were received, cancellation would occur. This holds true throughout the infinite spectrum of Fresnel zone radii. Odd-numbered zones reinforce; even numbered zones cancel. Fortunately, most of the power is in the first dozen or so Fresnel zones. So we may limit our concern in a practical fashion to those zones.

We can calculate the radius of the first Fresnel zone and compare this with the passive repeater aperture to find some interesting comparisons. Assume two paths, path 1 being 30 miles long and path 2 being 2 miles long. In Fig. 3, it has been determined that a repeater is required at point B to connect points A and C. Assuming we plan to use a passive rather than an active repeater, we are curious to know what the full first Fresnel zone radius would be for such an arrangement so we may compare this with passive repeater

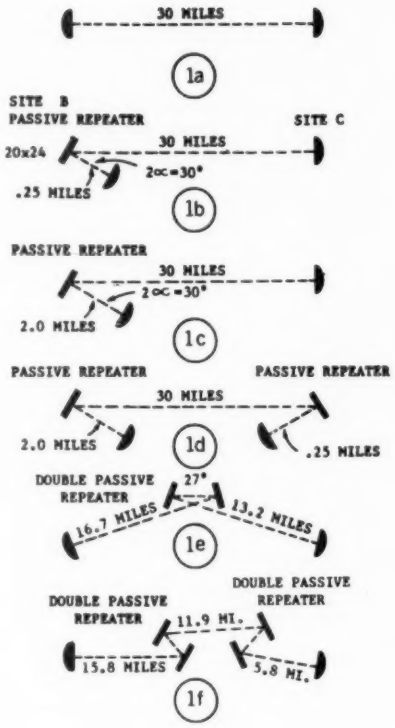


Fig. 3. Variations of mW paths.

apertures. To determine Fresnel zone radius we apply

$$R_f = 2280\sqrt{\frac{(n)\,d_1 d_2}{D\,f}}$$

where

R_f = radius of the n Fresnel zone
n = number of the Fresnel zone of interest
d_1 = length of path 1
d_2 = length of path 2
D = combined length of the two paths
f = operating frequency in megahertz

So, assume we are going to operate a microwave link on 10.125 GHz and we wish to know what the radius of the full first Fresnel zone would be for the paths above. Our calculations would look like this:

$$R_f = 2280\sqrt{\frac{(1)(30)(2)}{(34)(10{,}125)}}$$

$$= 2280\sqrt{\frac{6.0 \times 10^1}{3.442 \times 10^5}}$$

$$= 2280\sqrt{1.777 \times 10^{-4}}$$

$$= (2280)\,(.0143)$$

= 32.6 ft for the radius of the first Fresnel zone under the conditions outlined above.

Now, if we were to construct a reflector with a radius of 32.6 ft, we would find that we are intercepting all of the radiated energy that has a positive phase relationship and redirecting it in similar phase. Therefore, we are effectively increasing our power gain by a theoretical 6 dB. (See Fig. 4.) In practice it will be more like 5 dB or so, depending on the aperture coupling ratio of the passive repeater to the parabolic antenna that excites it. This gain is antenna system gain in a near field condition, and is added to the gain of the exciter parabola. To prove this mathematically, refer to the universal gain curve in Fig. 4 and compute for 1/K.

$$1/K = \frac{\pi\,\lambda\,d}{4\,A_e}$$

where,

$\pi = 3.14$

$\lambda = \frac{985}{f(MHz)}$

d = distance, in feet, between antenna and reflector

and where

A_e = effective area of reflector, (height x width x cosine of half the horizontal included angle).

A = (a) (b) for rectangle,

$A = \frac{(a)\,(b)\,(\pi)}{4}$ for ellipse,

$A = \pi r^2$ for circle.

So, for the link we're working with, let's check the 4-mile path first to see if we're

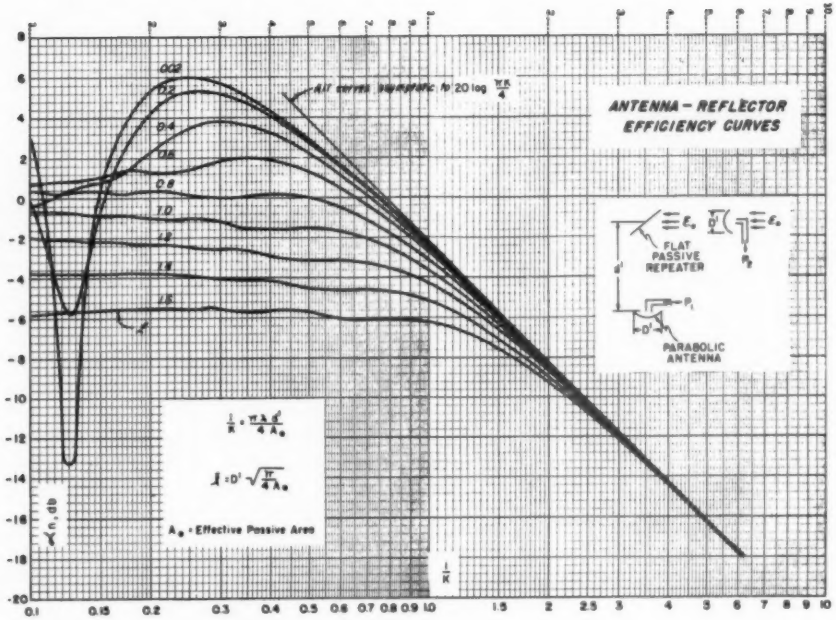


Fig. 4. Universal gain curve.

"near field." We determined earlier that for 10.125 GHz the radius of the first Fresnel zone would be 32.6 ft. Let's assume the reflector is an ellipse whose effective radius at the specific horizontal included angle, is 32.6 ft.

$$1/K = \frac{\pi \lambda d}{(4)(A_e)}$$

$$= \frac{(3.14)(985/10{,}125)(2)(5{,}280)}{(4)(32.6)(32.6)(3.14)}$$

$$= \frac{(3.14)(.0972)(2)(5{,}280)}{(13{,}300)}$$

$$= \frac{3210}{13{,}300} = .24$$

A word of caution here: Don't take mathematical shortcuts such as dropping out π in the numerator and denominator. The total value of (4) (Ae) will be required for later calculations. Shortcut math, if used with caution, is okay, but watch it if values are to be used later; otherwise, erroneous results will be obtained. Having determined 1/K to be 0.24 we have one more step to perform before going to the universal gain curve of Fig. 4. Before that, though, if should be noted that if 1/K computes to be 2.5 or less if a near field condition does exist. If 1/K is 2.5 or greater, a far field condition exists. If 1/K is exactly 2.5, either near or far field methods may be used to determine system gains. Refer to Fig. 5 for further discussion of near field and far field.

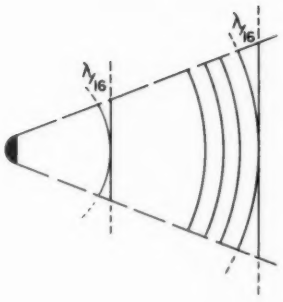
Now, the next step we have to determine is the aperture coupling ratio – that is, the ratio of the passive repeater aperture to the exciter parabola aperture. To do this we manipulate the following:

$$l = D\sqrt{\frac{\pi}{4\,A_e}}$$

where D = diameter of exciter parabola,
$\pi = 3.14$
A_e = effective area

So, for this situation, let's assume a 10 ft parabola. Then,

$$l = 10\sqrt{\frac{3.14}{(4)(32.6)(32.6)(3.14)}}$$
$$= 0.235$$



WHAT ARE NEAR FIELD AND FAR FIELD? THE CLASSICAL DEFINITION OF THE OCCURRENCE OF NEAR FIELD IS THE POINT WHEN A RADIATED WAVE (THE MICROWAVE BEAM) INTERCEPTS A PLANE SURFACE (THE PASSIVE REPEATER) AND THE DIFFERENCE BETWEEN ANY POINT ALONG THE RADIATED WAVE AND THE PLANE SURFACE IS λ /16 OR GREATER. NOTE THAT EITHER MOVING THE PASSIVE REPEATER CLOSER TO THE SOURCE OR MAKING THE PASSIVE REPEATER LARGER CAN RESULT IN CREATING A NEAR-FIELD SITUATION. THIS CAN BE USED TO GOOD ADVANTAGE WHEN ENGINEERING A PASSIVE REPEATER PATH.

Fig. 5. Near Field/Far Field discussions

Having 1/K = 0.24 and l = 0.235 we now go to the universal gain curve of Fig. 4. Enter the graph at the bottom where 1/K = 0.24. Read vertically to where l = 0.235. (You'll have to visually interpolate here a bit.) Then read horizontally to the left where you'll find the gain to be added to the antenna system gain. This will be an additional 5.0 dB. A 10 ft parabola at 10.125 GHz has a gain of about 47.5 dB. Add to this the 5.0 dB derived above, and we have a total antenna system gain of 52.5 dB above an isotropic point source. The purpose of showing this near field application, with its 32.6 ft reflector radius, is to illustrate the interrelationship of operating frequency, size of the reflector, and spacing as they affect near field. Few hams are going to construct a reflector with a 32.6 ft radius. Indeed, ham applications will seldom call for anything on this order of magnitude. But for commercial systems, it is a very practical application, and in fact has been done.

Ham Passive Applications

Engineering a microwave path with a passive repeater is actually no more difficult than engineering a direct microwave path. Contrary to popular opinion, there are absoluteiy no rules of thumb involved in engineering a radio path using a passive repeater. Let's face it: if rules of thumb worked, there would be no need for engineers! The only things used are proved engineering techniques that make the selection of the proper passive repeater a task of less than a few minutes.

Basic Microwave Path

Probably the best way to learn about passive repeater engineering is to perform some sample calculations. It will be assumed that the reader has a basic knowledge of logarithms and trigonometry and can perform the necessary logarithmic conversions. The basic microwave point-to-point system of Fig. 3A would be calculated as follows:

First, in all cases, λ, in feet, will be

$$\frac{985}{f(MHz)}$$

Then, we need to assign system values. Let's have the transmitter operating at a frequency of 1250 MHz, with a power output of 1W, 20 ft of 7/8 in. foam-filled transmission line, with 6 ft parabolas at each end. The path, as shown in Fig. 3A, is 30 miles long. Now, we convert all our parameters to decibels. It is convenient to tabulate them as gains and losses.

Gains:

+30 dBm transmitter output (Fig. 6)
24.5 dB 6 ft parabola (Fig. 7)
24.5 dB 6 ft parabola
+79.0 dB

Losses:

128.0 dB 30 miles at 1.25 GHz (Fig. 8)
0.42 dB 20 ft 7/8 in. coax (Fig. 9)
0.42 dB 20 ft 7/8 in. coax
1.0 dB connectors
129.84 dB

-129.8
+ 79.0
50.8 dBm received signal level (input to receiver).

With an FM improvement threshold level of -81 dBm this will give us a 30.2 dB fade margin.

Basic Passive Microwave Path (Near Field)

The first step in calculating the gains and losses of the path shown in Fig. 3B is

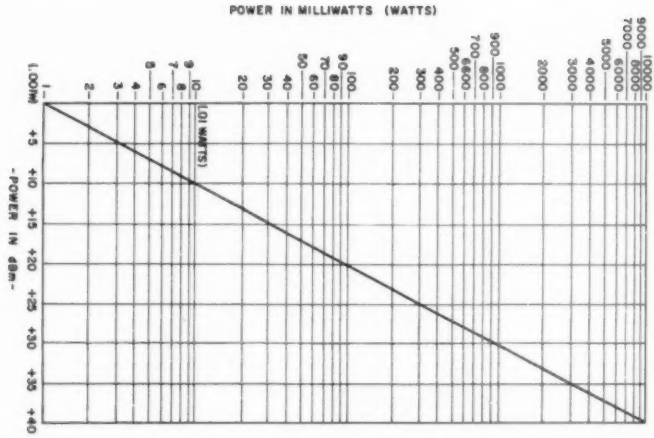


Fig. 6. Transmitter output/dB conversion chart.

to calculate the path loss of the long path as already performed above. Then with loss of the long path established, it is necessary to determine whether the short path, from site A to site B, is a near-field or far-field condition, by using the following formula:

$$1/K = \frac{\pi \lambda d_1}{4 A_e}$$

where λ is wavelength in feet, d_1 is length of path in feet, and Ae is the effective area (actual area times cosine of half the horizontal angle) in square feet, of the passive repeater.

Let's change transmitter frequency now, going to 5.787 GHz, but keep all other equipment parameters the same, except we'll change to a good-grade waveguide, since we're to be in the higher frequency. A waveguide similar to EW-59 shown in Fig. 10 will suit our purposes.

$$1/K = \frac{(3.14)\,(0.17)\,(5280)\,(0.25)}{(4)\,(20)\,(24)\,(\cos 15^\circ)}$$

$$= \frac{706}{1875} = 0.387$$

If 1/K calculates to be 2.5 or less, the path from terminal to passive repeater is considered near field. Thus, 0.387 is a near-field situation. The 2.5 just mentioned is not a rule of thumb. This is the crossover

Parabolic Antenna Gain

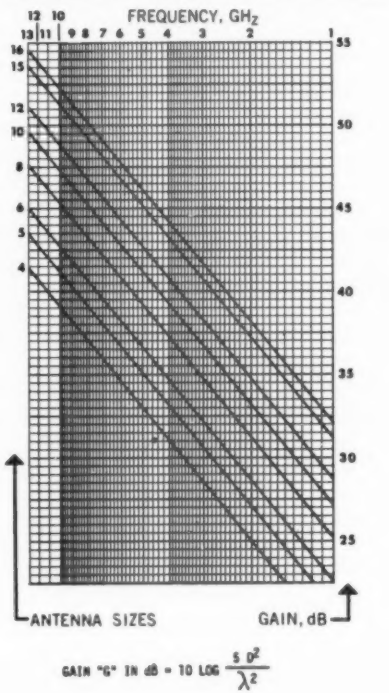


Fig. 7. Antenna gain.

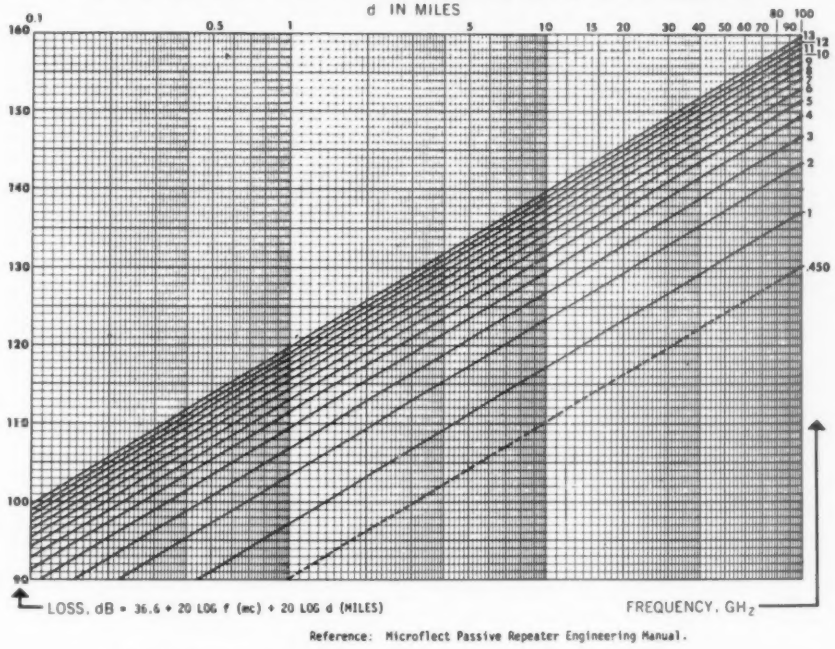


Fig. 8. Free space path loss.

point where there is λ/16 difference between the curved wavefront and the edge of the passive (See Fig. 5) and where the computations may be based on either the near field or far field method.

Next, since we are in a near field condition, the function *l* (the parabola/reflector coupling factor), must be determined:

$$l = D' \sqrt{\frac{\pi}{4\,A_e}}$$

where D' is the parabola diameter in feet, and Ae is the effective area of the passive repeater.

Then, for the situation in Fig. 3B:

$$l = 6 \sqrt{\frac{3.14}{(4)\,(20)\,(24)\,(0.9659)}}$$

$$= 6\ \sqrt{0.00169}$$

$$= (6)\,(0.041) = 0.246$$

Now, referring to the curves in Fig. 4, the value of 1/K (0.387) is located on the 1/K scale. A vertical line is run to the curve corresponding to the 0.246 figure obtained for *l*. (Interpolation is necessary, here.) At this point, a horizontal line is run to the *a*, dB scale and the near field gain (or loss, as the case may be) is read directly in dB. For this situation, we have 4.3 dB gain.

Adding all the gains and losses, we get:

Gains:

+ 30 dBm transmitter output
38 dB 6 ft parabola at 5.787 GHz
38 dB 6 ft parabola at 5.787 GHZ
4.3 dB near field gain
+110.3 dB

Losses:

141.3 dB 30 miles at 5.787 GHz
0.7 40 ft waveguide
1.0 connectors, etc.
-143.0 dB

-143.0
+110.3
- 32.7 dBm rf input to receiver

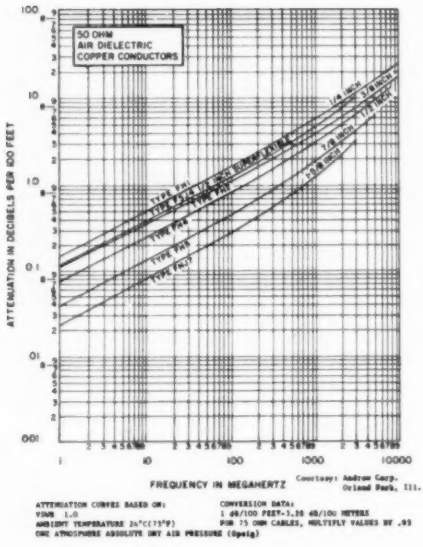


Fig. 9. Foam filled loss chart.

So, if our receiver still has a -81 dBm FM improvement threshold, we will have a fade margin of 48.3 dB. Now, if we feel we need a smaller fade margin, we can reduce the size of our passive repeater, as necessary, to give us the specific fade margin or receiver signal level we want.

Basic Passive Microwave Path (Far Field)

If 1/K should calculate to be 2.5 or greater, we have a far-field condition. Figure 3C is a far-field path at 5.787 GHz, with

$$1/K = \frac{(3.14)(0.17)(5280)(2.0)}{(4)(20)(24)(\cos 15^\circ)}$$

$$= \frac{5640}{1875}$$

$$= 3.0$$

Since it is a far-field situation, we treat the 2-mile path just like the 30-mile path, with a specific path loss shown in the calculations.

Also, with a far-field situation, it is necessary to consider the gain of the passive repeater directly in the calculations.

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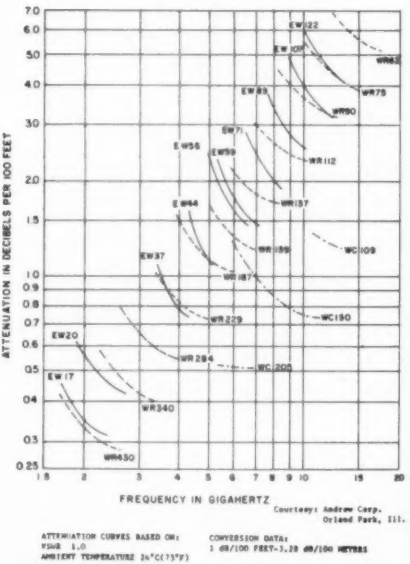

Fig. 10. Waveguide loss chart.

Referring to Fig. 11, we find the gain of the 20 x 24 passive repeater. The graph is entered at the top left at the horizontal included angle. The horizontal included angle of Fig. 3C is 30°. The graph is then read down to the curve corresponding to 20 x 24, then horizontally across to the frequency of operation (5.787 GHz), then down to the gain figure for the passive repeater (106.4 dB). Again, the gains and losses are totaled:

Gains:

+30 dBm transmitter output
38 dB 6 ft parabola at 5.787 GHz
38 dB 6 ft parabola at 5.787 GHz
106.4 dB 20 x 24 passive repeater with $2\alpha = 30°$ at 5.787 GHz
+212.4 dB

Losses:

141.3 dB 30 mile path at 5.787 GHz
117.8 dB 2 mile path at 5.787 GHz
1.7 dB 40 ft waveguide, connectors, etc.
-260.8 dB

-260.8 dB
+212.4
-48.4 dBm Re input level to receiver.

Using the same -81 dBm threshold level, this -48.4 dBm received signal level would give us a fade margin of 32.6 dB.

One Path – Two Passive Reflectors

Figure 3D shows a common passive-repeater application where there are two passive reflectors in one path. The two passive reflectors are treated individually, as above, determining whether each is near field or far field, and the loss of the 30-mile path is calculated as usual. In practical application there are a number of variables to control the system component sizes to achieve the proper fade margin or minimum median received signal level (such as parabola size, passive repeater size, distance between passive repeater and parabola of given size, horizontal included angle, frequency and transmitter power). Economics and system noise requirements will dictate which component to vary in a

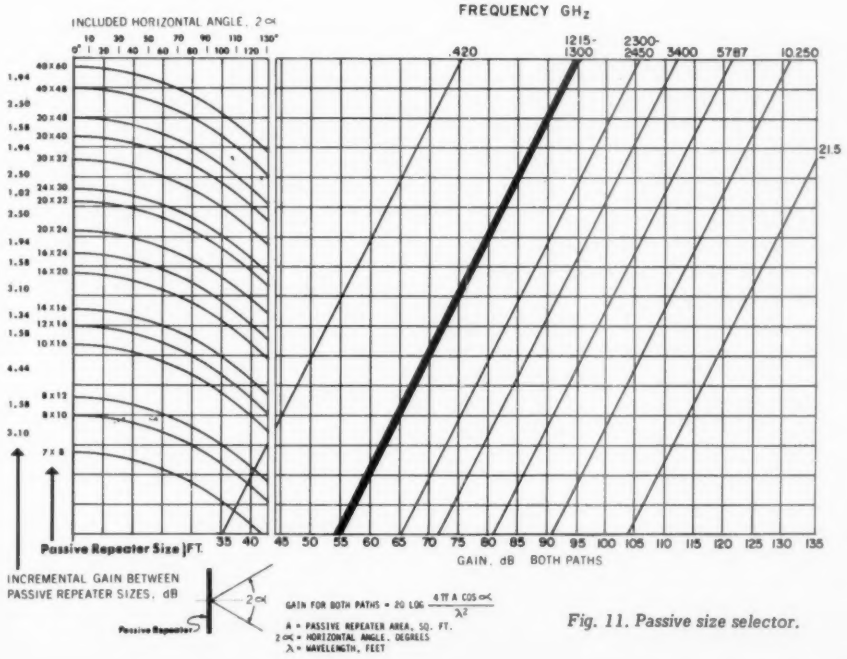

Fig. 11. Passive size selector.

given situation. In the examples shown, we have varied the parabola sizes, using practical commercially available sizes. In the arrangement for Fig. 3D, it will be necessary to substitute a 10 ft parabola for the 6 ft parabola used in the calculations associated with Fig. 3B, keeping the passive repeater size the same. This means it will also be necessary to recalculate the value of *l* if the 10 ft parabola is placed at the terminal with the near field path. If it is placed at the terminal with the far field path, there will be no requirement to recalculate this value. For convenience and aperture coupling efficiency, we will place the 6 ft dish at the near field terminal and the 10 ft dish at the far field terminal.

So, for path arrangement of Fig. 3D we have gains and losses totaling:

Gains:

+ 30 dBm transmitter output
38 dB 6 ft parabola
42.5 dB 10 ft parabola
4.3 dB near field gain
106.4 dB 20 x 24 ft passive with 2α - 30° at 5.787 GHz
221.1 dB

Losses:

141.3 dB 30 mile path at 5.787 GHz
117.8 dB 2 mile path at 5.787 GHz
1.7 dB 40 ft waveguide, connectors, etc.
-260.8 dB

-260.8 dB
+221.2 dB
-39.6 dBm rf input to receiver, for a fade margin of 41.4 dB

Double Passive Repeaters

Perhaps one of the more frightening arrangements of passive repeaters, to the uninitiated, is the double passive repeater. Actually, double passive repeaters are no more difficult to engineer than any other passive repeater arrangement. There are a couple of additional manipulations required, but with the availibility of curves and graphs, most of the work is eliminated.

Double passive repeaters can be used to overcome on-path obstructions and eliminate the need for active repeater facilities.

Double-passive repeater engineering is performed just as single-passive-repeater engineering, with one additional step. First, as with the single passive repeaters, it is necessary to determine if the passive repeater is in the near field with respect to the close parabola. Seclecting the configuration in Fig. 3E, it is almost obvious that the 13.2 mile separation on the short path will result in a far-field situation. Because of distance, 30 x 40 ft reflectors will be used. Figure 12 details the layout of this double-passive-repeater shot, which is known as an "X" configuration. First, the near-field check is made:

$$1/K = \frac{(3.14)\,(0.17)\,(5280)\,(13.2)}{(4)\,(30)\,(40)\,(\cos 13^\circ 30')}$$

$$= \frac{37200}{4700}$$

$$= 7.91$$

which is definitely far field. And, since the other path is even longer, it may also be assumed to be far field.

At this point, it is necessary to determine the gain of the passive repeater. This may be done either by referring to the curves in Fig. 11, or in the case where curves are not available, the gain of the passive reflector may be calculated. To calculate passive repeater gain, the passive repeater which has the smaller effective area (actual area times the cosine of half the larger horizontal included angle) must first be determined. In the case of Fig. 12, both horizontal angles are the same (27 degrees) and both passive repeaters are the same size, so it will make no difference which we select for calculation purposes.

The gain of a 30 x 40 ft passive repeater at 5.787 GHz, with a horizontal included angle of 27 degrees is:

$$20 \log_{10} \frac{4\pi A \cos \alpha}{\lambda^2}$$

$$20 \log_{10} \frac{(4)\,(3.14)\,(30)\,(40)\,(0.9724)}{(0.17)\,(0.17)}$$

$$= 20 \log_{10} \frac{14{,}650}{0.0289}$$

$$= 20 \log_{10} \frac{1.465 \times 10^4}{2.89 \times 10^{-2}}$$

$$= 20 \log_{10} 5.06 \times 10^5$$

$$= (20)\,(5.704) = 114.08 \text{ dB}$$

where A = actual passive area in square feet, cos α = cosine of half the horizontal included angle, and λ^2 = wavelength in feet, squared.

There will be a slight amount of coupling loss between the two passive repeaters. The coupling loss for various spacings and passive orientations may be determined by use of the curves in Fig. 1 and the associated calculations. For example, for the conditions in Fig. 3E and Fig. 12, it would be necessary to check the b/a ratio of the two passive repeaters. This is done by determining the effective area of each of the two passive repeaters:

$$A_e = (30)(40)(0.9724) = 1168$$

$$a = 34.19$$

$$B_e = (30)(40)(0.9724) = 1168$$

$$b = 34.19$$

$$b/a = \frac{34.19}{34.19} = 1$$

If there should be a difference in the size of the effective areas, the larger effective area is considered to be b.

Determining the value of $1/K^2$ to complete the double passive repeater efficiency calculation, we find that:

$$1/K^2 = \frac{2\lambda d_1}{A_e}$$

where λ = wavelength in feet, d_1 = the separation between the two passive repeaters, and Ae = the effective area of the smaller of the two passive repeaters. The separation between the two reflectors is not critical. At frequencies above about 2 GHz and with passive repeater sizes larger than about 16 x 20 ft, the spacing may extend to as much as 1000 ft without degrading the gain of the double passive more than 2 dB. Let's assume 500 ft for the example in Fig. 12.

$$1/K^2 = \frac{(2)(0.17)(500)}{(30)(40)(0.9724)}$$

$$= \frac{170}{1168} = 0.1455$$

This places the $1/K^2$ point of Fig. 1 along the left margin of the graph. Following the $\frac{b}{a} = 1$ curve, we find a coupling loss of about 0.9 dB.

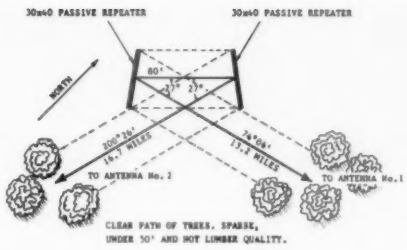

Fig. 12. Double passive repeater with horizontal included angle of 27°. Typical layout.

Losses:

134.2 13.2 miles at 5.787 GHz
136.2 16.7 miles at 5.787 GHz
1.7 dB 40 ft waveguide and connectors
0.9 dB double passive coupling efficiency
273.0 dB

273.0 dB
+229.1
43.9 dBm rf input to receiver; fade margin of 37.1 dB

Totaling system gains and losses:

Gains:

+30 dBm transmitter power output
42.5 dB 10 ft parabola at 5.787 GHz
42.5 dB 10 ft parabola at 5.787 GHz
114.1 Passive gain 30 x 40 ft at 5.787 GHz
+2291.1 dB

The calculations and path sketches shown on the preceding pages are not just theoretical. Similar configurations have been installed using passive repeaters hundreds of times during the 20 years or so that microwave has been a communications tool and not an experimental toy. A high percentage of the passive repeaters installed, though, have been installed only in the last 5 years or so. This is because of the spread through the communication industry of the knowledge of the techniques of passive repeaters. It is also due in great part to the demise of "rules of thumb" which formerly played a great part in the "engineering" of early-day microwave systems. One favorite rule of thumb that used to be touted and that really has no basis in fact, is the one that said, "If the product of the path lengths exceeds 30, then a passive

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repeater cannot be used." This meant that the configuration of Fig. 3E, with a product of (13.2)(16.7) = 220.4, wouldn't work. Not only will it work, but there are passive repeater systems just like it all over the world that do work and are in operation today, yet the product of their path lengths exceeds 30, even 130 and even 430.

The moment the serious microwave ham recognizes that fact, he will be ahead of many professional engineers and on his way to becoming a specialist in a specialized field.

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Converting the AC/DC for WWV

Perhaps the single most complete piece of gear to invade the junkbox is the standard ac/dc five-tube table radio. Millions of these radios have been produced over the years, and they inevitably end up in the junk heap or are presented to the "ham" by good intentioned friends because they know "you like radios."

They go bad for any number of reasons, but mainly the problem is failure of tubes, electrolytic capacitors, or the output transformer. Other simple problems such as cabinet breakage or dial cord problems also tend to render the ac/dc useless to the owner.

Having an unusually large supply of these on hand, the thought occurred to me that the circuits are most always the same. An antenna loopstick or ferrite rod and coil forms the basis of the rf input circuit which is fed directly into a "converter." The antenna coil is tuned across the BC band by one section of the control grid and cathode of the converter and is tuned by the other section of the variable capacitor. When the two signals are mixed the resulting output of 455 kHz is produced, detected, and amplified. In most cases this converter tube is a 12BE6 and operates in conjunction with a 12BA6, 12AV6, 50C5, 35W4. Not coincidentally, the total filament voltage in series is 115V (see Fig. 1).

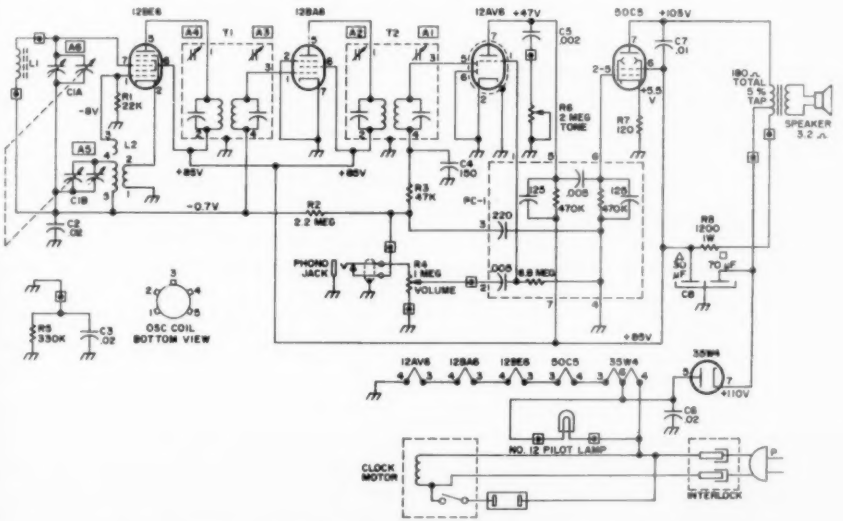

Fig. 1. Unmodified circuit of a typical ac/dc braodcase band receiver.

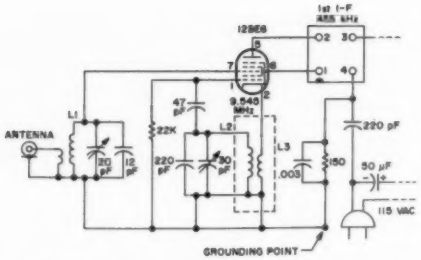

Fig. 2. Modified circuit of 12BE6 converter for WWV.

Converting the ac/dc to any fixed frequency between 1 and 30 MHz couldn't be simpler.

Remove the 365 pF variable, the ferrite coil, the oscillator coil, and all wires connecting to pin 7, 1, and 2 of the 12BE6. (Of course, you should make sure the ac/dc is operating before assembling to save some problems later on.) Next, remove all the coil windings from the oscillator coil form. This coil form is handy for the new oscillator coil and usually has mounting lugs and brackets already provided. When removing components, carefully trace all the ground wires to a single point. This is the grounding point that should be used, as it is usually isolated from the 115V ac line.

Using 26 AWG copper enamel wire, first wind a 5-turn link on the oscillator coil form connecting it to two unused lugs. Then scramble-wind the oscillator coil over the link and connect one lead to the ground lug of the link and the other to a third unused lug. Parallel a mica capacitor of between 50 and 200 pF and a 0–30 pF ceramic trimmer across the oscillator coil. Remount the coil and connect the link to the cathode (pin 2), and tie the oscillator coil to the control grid (pin 1) through a 47 pF capacitor. Insert a 22Ω, ½W resistor from pin 1 to the grounding point. Check the coil for resonance with a grid dip meter and then add 455 kHz for the indicating frequency.

In my case I desired a reception frequency of 10 MHz for WWV and found that my oscillator coil tuned from 6.5 to 10.5 MHz with the trimmer specified.

The rf section was all that remained; it consisted of 30 turns on a 3/8 in. coil form paralleled by an APC 20 pF variable and a 12 pF mica capacitor, making the coil resonate between 11 and 9 MHz. This assembly can be mounted on the bracket used to support the old 365 pF variable capacitor. Figure 2 shows the revised circuit for the 10 MHz WWV receiver. Wiring is by no means critical and mounting of an assortment of parts can be left to the constructor's imagination. Care must be taken, however, to isolate the chassis ground from all components. If an external antenna is used do not ground either lead and make sure the "safe polarity" is established when plugging in the set.

Operation

Rough adjustment can be made with the grid dipper when putting on frequency. The antenna trimmer is used to peak the signal and the oscillator trimmer adjusts frequency.

The i-f coils need not be touched as they still operate at 455 kHz. I found my new WWV monitor to be quite stable and to produce excellent quality in Pennsylvania, even during the daylight hours. In tuning the oscillator trimmer slightly up and down the band, I got equally pleasing results. No difficulty in producing a fixed receiver for any desired frequency should result, as long as the oscillator coil and antenna coil are properly adjusted.

Some future modifications might involve replacing the 12AV6 detector tube with diodes and inserting a tube with equivalent filament current and voltage for a 455 kHz bfo. Also, the detector stage could be disconnected from the audio circuit and capacitively coupled to the speaker for a code practice oscillator. In all there are, and will continue to be, many uses for this common receiver, so when somebody gives 'em away . . . take 'em

. . .W3JJU■

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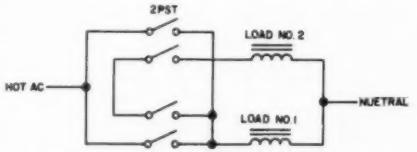

Fig. 1. Schematic for a two load fail safe arrangement.

Have you ever had a desire for a fail safe method of turning on the filaments prior to turning on the transmitter high voltage supply? Or how about a guarantee that the bias power supply will always be turned on first, so that bias voltage would be present on the transmitting tubes prior to the time that the plate supply was turned on? Perhaps you need to turn on the final plate supply prior to turning on the modulator plate supply, in order to protect the modulation transformer. Operating the modulator without a load can cause excessively high voltages to appear across the modulation transformer windings. Result–shorted transformer.

At this point someone is bound to say "Who uses a modulator in this day and age of Sideband". Well for the SSB boys; you may want to work up a fail safe arrangement to turn on the final plate supply to that 4-1000 prior to turning on the screen supply. If you aren't careful––BLOO–Y––the screen current will rise to excessive values and there goes another expensive final.

For most home constructed equipment, the only parts required are two DPST toggle switches. The schematic for a two load fail safe arrangement is shown in Fig. 1.

This system can be carried a bit further and by using three each 4 pole switches any three load circuits can be turned on in a 1-2-3 order. No matter which switch is operated first, the no. 1 load is turned on. The second switch to be operated turns on the no. 2 load, and the last switch to be operated turns on the no. 3 load. At this point, operating any one of the switches to the "off" position will disconnect the no. 3 load. The second switch to be turned "off" will disconnect the no. 2 load, etc. The schematic for this arrangement is shown in Fig. 2.

Other uses for this switching arrangement will no doubt come to mind, such as:
1. Always turn on the SAFE light in a photographic dark room prior to turning on the enlarger.
2. Always turn on the cooling fan ahead of the filament transformer when using air cooled tubes.

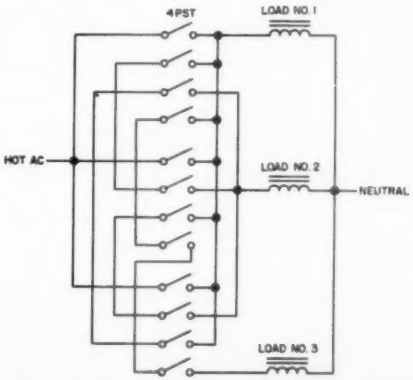

Fig. 2. A three load circuit can be turned on in 1-2-3 order by using this arrangement.

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3. Turn on your CB receiver prior to turning on the transmitter. Many CB'ers leave their receivers on for monitoring purposes, and with the squelch operated, it may be difficult for non-technically minded persons—your mother-in-law, for instance—to know whether they turned on the transmitter or the receiver. Just explain to them to operate either switch to turn on the receiver.

4. How about turning on the RTTY power supplies prior to turning on the printer motor?

If the two or more pieces of equipment are widely separated, it might be best to mount the switches and provide outlets in a small Minibox. Be sure to label the outlets 1,2 or 3 to indicate which outlet will energize first, second or third. Plug the equipments into the Minibox and connect the Minibox cord to the electrical wall outlet.

You can also fool your friends with such a box. Plug two or three lamps, as the case may be, into the outlets and let them guess which switch controls which light.

. . . W7CJB

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BACK TO MOTHER EARTH THE EASY WAY

Here's an easy way to let hydraulics (via a garden hose) do the working to establish a good ground connection for home station or antenna array.

The importance of a good earth ground to an amateur radio station was iterated in QST (Aug 1970, p.38). The point is an important one. Improper grounding can cause weird radiation patterns, severe energy losses, and in some cases a serious shock hazard to the operator. QST's solution to the grounding problem is an excellent one: a 10 ft length of galvanized iron rod, sledgehammer-driven into the ground.

My problem is that I have had difficulty finding 10 ft tall acquaintances willing to come over and wield the sledge.

The solution, it turns out, is simple. From your neighborhood hardware store, buy a length of ½ in. rigid copper pipe and a brass female hose connection to match. While you're there, pick up a bit of solid solder and a length of the leaviest wire you can find.

Use a torch to solder the fitting to one end of the pipe. Clean the pipe and fitting, tin the pipe all the way around with the solid solder, and put the preheated fitting in place. As it's only temporary, the joint needn't be "plumber approved."

The site for the ground rod should be chosen to give a short run to the shack (or in the middle for an array) and to have overhead clearance to wield the 10–20 ft pipe for insertion. It should be more than a foot or so from the basement wall to insure clearing the footings, and with luck, it should be within hose-reach of the nearest

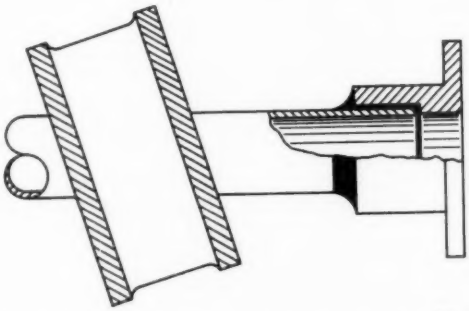

Fig. 1. Female hose connector is sweat-soldered to rigid copper ground pipe. Solder is shown in solid black. Use a blowtorth and plenty of heat. If the hose coupling is forgotten, it can be easily slipped over the plain end of the pipe after the soldering is finished. Soldering in a pipe to pipe coupling for a longer ground rod is similar although less convenient because the pipe will be vertical. Have a friend hold the upper pipe.

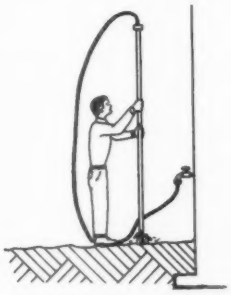

Fig. 2. Insertion of the ground rod. The flowing water will "erode" a hole out ahead of the pipe. The pipe should be started far enough from the wall to miss the concrete footings if they are present. Stop dropping the pipe (and shut off the water) before the top of the pipe is even with the ground to ease removal of the coupling and soldering of the bus. After the bus has been installed, stepping on the pipe will force it down to ground level.

outdoor faucet. Hook up the hose, turn on the water full blast, and with the hose-end of the pipe in the air, drop the pipe straight into the ground. It will sink with a minimum of effort as the flowing water bores the hole ahead of it.

Judicious wiggling will clear most underground obstructions. If you hit one too big to pass, lift the pipe out and try again with a new hole. Leave about a foot of pipe sticking out of the ground.

Unhook the hose, let the water drain away, and unsolder the hose connection. The bus wire can now be soldered to the top of the pipe while the solder is still melted. Foot pressure on top of the pipe will now drop it even with the ground where it will pose less of a danger to kids and burglars sneaking around outside the house in the dark.

The ground bus should be routed to the shack by the most direct route, keeping in mind that it is an rf connection as well as a dc one. Many plush installations run the ground bus directly to a grounding bar, which may be fitted with pin sockets or binding posts, and runs across the back of the work table.

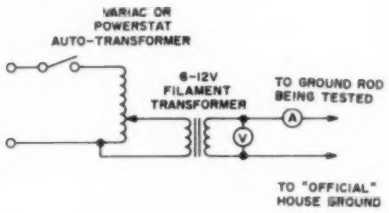

Fig. 3. Cheapie circuit for checking the ground if you don't have a "megger" handy. Voltmeter should read higher than the output of the filament transformer. The ammeter should read about one amp full scale. In addition to lowering the voltage, the filament transformer provides isolation between the line and ground. Don't try this circuit without it. To test the ground, set the autotransformer to zero and close the primary switch. Slowly turn the voltage up while watching the ammeter. When you get an ammeter reading like 0.5–1A, note the corresponding voltage and shut off the power. Resistance is calculated from Ohms Law (R = E/I). 25Ω or less and you have a good ground. A higher resistance may mean that the "house ground" doesn't get to the local soil, and the ground rod is still okay.

After the rod is installed, it may be some time until the soil resettles around the rod. This action can be hastened by gently flooding the area with water, as with a lawn sprinkler, and by tamping the area around the rod with a broomstick.

Checking the effectiveness of the final installation can present a problem, in that if you had a really good ground to begin with, you wouldn't have put in another. Probably the best reference is the house ground, used by the power and telephone companies, and connected (the green lead) to each box housing an electric outlet or switch (it says here). An ordinary ohmmeter is useless for this measurement. Stray electric fields can build up voltages that, with a high impedance instrument, can be positively frightening. Rather, connect a low voltage source such as a variac-fed filament transformer in series with an ac ammeter, and hook this between the house ground and your ground. Monitor the applied voltage with a voltmeter and compute the resistance to your ground using R = E/I.

If the ground doesn't seem to be as effective as you'd like, there are three remedies. For the short term (perhaps longer with luck) soaking the area around the ground rod with water should increase subterranean conductivity. If this doesn't help, add salt. Copper sulfate is good if it is convenient, otherwise table salt is fine. Spread a pound or so around the rod and soak it in with water. The last resort is a longer rod (or another separate ground rod). To lengthen the rod, merely lift it out of the ground a bit, unsolder the bus lead and replace it with a coupling. Solder on another length of pipe fitted with the hose connector on the other end, and let 'er go.

Unfortunately, grounds, like everything else, deteriorate with age. If salt is used, it eventually leaches away, and often the pipe will build up a high resistance layer. Check the ground resistance once a year or so, when you "pull maintenance" on the rest of the gear in the shack. If you maintain the system this way, you too will be able to tell your friends that you are "well grounded" in amateur radio.

. . .WA1FHB■

3 dB for 3 bucks

John J. Schultz W2EEY/1
40 Rossie St.
Mystic CN 06355

Many of us sometimes get involved in rather elaborate antenna or amplifier projects in order to improve our signal by only a few dB. Some projects, particularly antenna ones, can benefit both transmission and reception and so the cost and effort involved might be considered more worthwhile. However, when a project provides only a potential improvement on transmission, a "plateau" is often quickly reached beyond which the dB gained to dollar ratio becomes very unfavorable.

This article explores one very simple and inexpensive means by which one can usually still gain a few dB of transmission effectiveness with any SSB equipment setup. If one has already glanced at the circuit diagrams, it may give rise to the idea that only simple "old hat" 300–3000 Hz audio response restriction is going to be suggested since the circuits are simple tone control types. However, that is not the case. Usually the audio and rf filter circuits in any modern SSB transmitter already sharply limit the audio response below 300 Hz and above 2500–3000 Hz. Many "communications" type microphones are also frequency response limited. Within the frequency response range, great care is also usually taken to insure that the response is "flat," on the theory that no narrow group of frequencies should restrict the overall peak power input. All frequencies are not equally effective in conveying understanding and if the frequency response could be properly tailored to favor such frequencies, improved transmission will result over a "flat" audio response. No increase in the power input or output of a transmitter will result from such audio response "tailoring" but better use will be made of the available power so that under *weak* signal conditions an apparent improvement of several dB in transmission effectiveness will usually result.

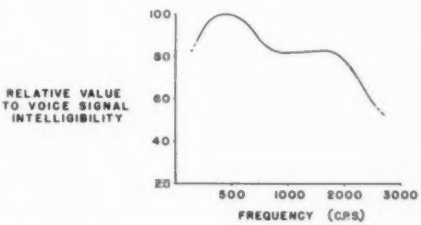

Fig. 1. As shown in this graph, all frequencies in the 300–3000 CPS range do not contribute equally to voice signal intelligibility. A completely "flat" audio response in a transmitter does not, therefore, provide the best voice signal effectivness.

Basic Concept

Many studies have been made concerning which frequencies are the most effective in conveying clear voice communications under both noisy and quiet conditions. Many such studies were made for the development of vocoders, for instance, where only selected portions of the speech frequency spectrum may be selected to eventually develop a composite narrow-band voice signal. Figure 1 is a generalized curve showing the relative value of each frequency in conveying clear voice communications. The very low frequencies are not extremely effective but there is a very interesting peak in the broad range of 375–550 Hz. Higher frequenices are also important until about 2000 Hz and then there is a rapid decrease in the relative effectiveness of still higher frequencies.

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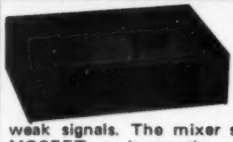

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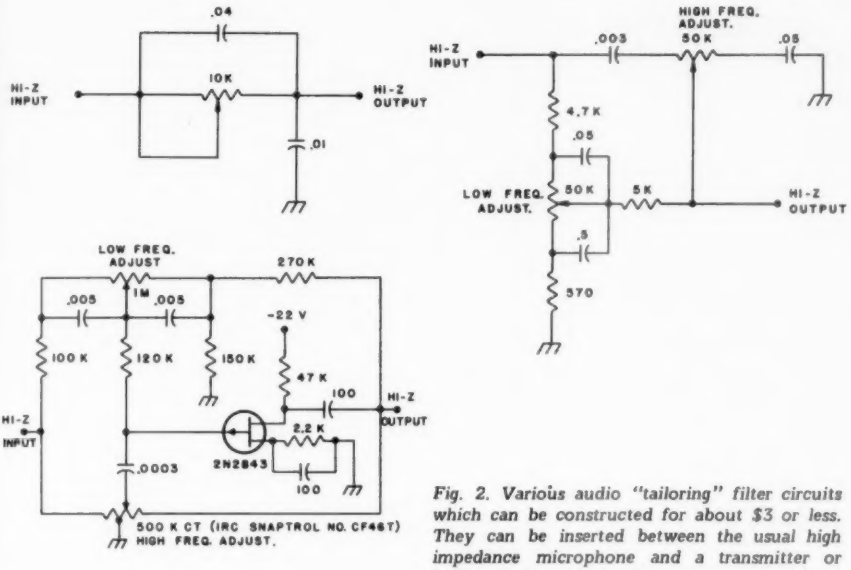

Fig. 2. Various audio "tailoring" filter circuits which can be constructed for about $3 or less. They can be inserted between the usual high impedance microphone and a transmitter or between the output of a compressor and the audio input of a transmitter.

A filter that would correct a "flat" response to conform to Fig. 1 would have to exhibit a sharply rising response below about 500–600 Hz and again from the 500–600 Hz mid-point, a gradually rising response for higher frequencies. Unless the transmitter af/rf circuits provided the necessary total bandwidth restriction, it would also have to have a very sharp cutoff below 300 Hz and above 2500–3000 Hz. Assuming that the latter function need not be provided by an auxiliary filter, many simple audio shaping circuits can be used. Fig. 2 provides some examples.

The circuit of Fig. 2A is about as simple as one can get. It can be inserted directly in a high impedance microphone lead or in the lead between a compressor or preamplifier output and a transmitter. The loss it introduces can easily be taken up by the reserve gain of most transmitter microphone amplifiers. The circuit of Fig. 2B is really a standard high-fidelity tone control unit but quite useful since it provides separate low and high frequency boost and attenuation. Such a circuit could easily be assembled on a piece of Vectorboard and placed inside a compressor enclosure. Miniature PC board trim potentiometers can be used since once initially adjusted, the unit can be left alone. The circuit of Fig. 3C using a Siliconix FET provides even more elaborate and exact frequency response "tailoring" to assemble the circuit in a Minibox enclosure using a battery supply (the current drain is less than 1 mA).

Adjustment

No matter which network is used, it generally does no good to set it up for proper frequency response using test instruments. It must be remembered that it's the total integrated audio response, starting at the microphone, which must be set for maximum effectiveness. Individual operator's voice characteristics and operating habits can also influence the adjustment. Some microphones change their frequency response, for instance, depending upon at what distance they are used, although the variation is not usually large with a good microphone. So, an on-the-air test is us-

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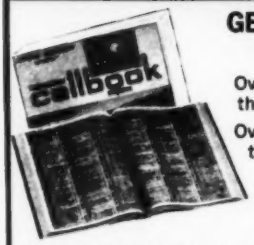

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ually the best means of adjustment. The power level that is used is not important and, indeed, for proper adjustment the transmitter output level must be reduced or the rf gain on the cooperating station's receiver turned back to simulate a *just barely* readable signal. The adjustment process is simple but it does require time and patience. The same number sequence should be repeated by the operator while each one of the two potentiometers of the filter unit is independently adjusted through its range (or the single potentiometer of the circuit of Fig. 2A). The receiving operator must continually keep the receiver rf gain turned back to simulate a very weak signal while he tries to distinguish which filter settings produce the most effective transmitted audio. Often, it will be found helpful to make provisions for removing the filter unit so a direct comparison can be made between the original audio setup and a setup using the filter set to what appears to be its optimum response. Care must be taken that the transmitter is modulated to the same power input level in each case. The effect of the filter will not be noticed by an increased "S" meter reading at the receiver but by a very distinguishable increase in the intelligibility of the audio under weak signal conditions.

Results

The author experimented primarily with the filter circuit of Fig. 2B used after a compressor. A good quality crystal microphone was used. After adjustment, comparison reports consistently indicated an increase in signal effectiveness equal to increasing the transmitter power level by several dB.

As long as one is willing to devote a bit of time to the adjustment process, audio "tailoring," by use of one of the filter units presented, will be found to be one of the easiest ways possible to add extra dB to an SSB signal. No internal modifications to a transmitter are necessary and usually passive circuitry can be used so that no power source is necessary.

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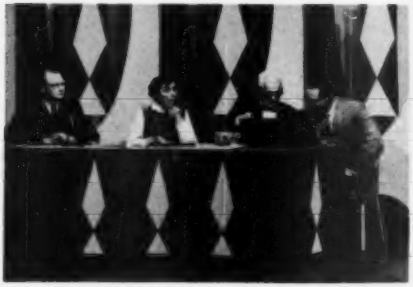
Radio amateurs reported special election issues directly from cities and towns to the Vermont Educational Television studios during the last election.



Two political commentators on the left stood by as Jim Viele (W1BRG) and Joe Frank (W1SOV) received returns from mobile stations through Vermont 2 meter FM repeater stations on Mt. Mansfield and Killington. Ham radio techniques provided service several hours faster than normal wire services.

Jim Viele (foreground) and Joe Frank report special returns from all over Vermont during the 1968 election over Vermont educational television network. Hams from all corners of the state reported directly to the studio with mobile stations on 2 meter FM frequencies through the Mt. Mansfield and Killington repeater stations. Report on returns were televised every few minutes as cameras were turned on the ham station. This technique made it possible to beat out normal wire-service reporting by several hours.

have a far better understanding of our significant contributions.

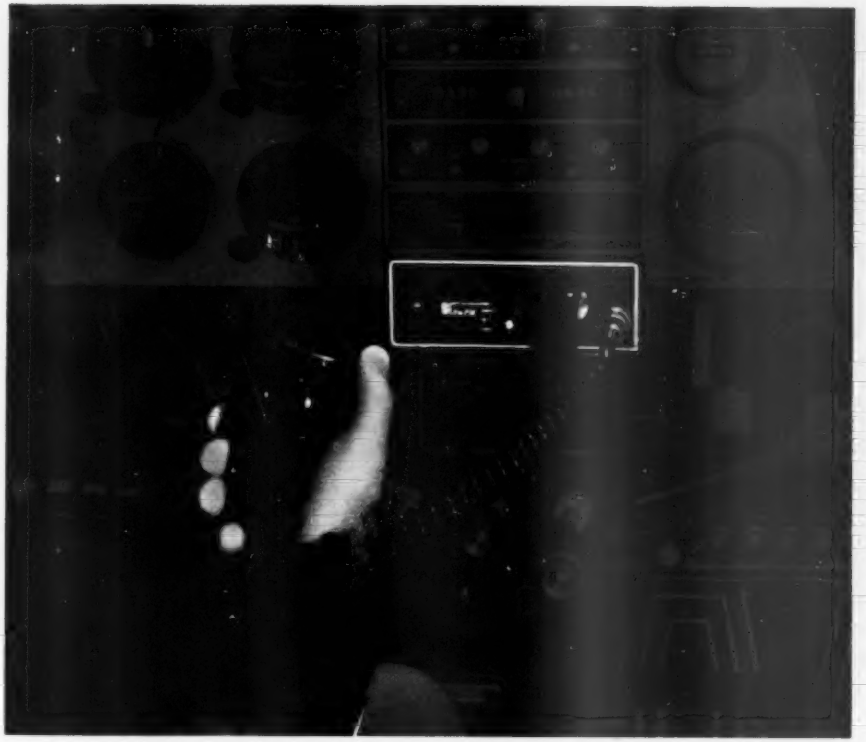
Why should we worry about it? We hams are licensed to operate in the public interest; our frequencies aren't granted solely for our own amusement. There is also a shortage of frequencies that's causing our neighbors in their squeezed channels to eye our bands enviously. Some of them see our bands as elbow room for *their* services and consequently they're running mimeograph machines far into the night turning out press releases jammed with reasons why it should be "them and not us."

We've got to justify our existence whether we like it or not! What happens to our frequencies may well be determined by public opinion and how it's impressed upon regulatory agencies and congress. Let's face it – public opinion is formed to a large extent by what people learn from newspapers, radio, and television. If we're not telling our story in a positive way, who will? Public relations is sorely needed!

What's public relations? One definition is simply: "Good performance publicly acknowledged and appreciated." Or how about: "Doing good and telling about it." We certainly qualify for the former, but fail in the latter!

The scope of this article isn't in what to do, but rather how to tell about it. Every ham has a chance to help out, and it certainly doesn't take a large, megabuck-financed national organization to do the job. We're talking about grass-roots publicity; zeroing in on *your community* with the radio amateur's story.

While it's true that radio clubs have more going for them in terms of activities to report – field days, traffic, radio classes – many equally newsworthy events are happening to individual hams all the time.



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The world's largest manufacturer of marine VHF equipment.

Thanks to the efforts of Harold (K2DLD) these Schenectady, N.Y., parents were able to phone patch with their sons and daughters during a singing tour of South America. This good example of public service resulted in favorable newspaper and television coverage.
Photo: Schenectady GE News

Recognize news when it happens! To be effective, you've got to have a story that will interest the news media. Since most news editors are pretty hard-nosed about what they accept, it helps to develop a feel for what will "sell."

Your dictionary may tell you that news is "something that just happened," but there's more to it than that. Wilbur Schramm once wrote in the *Journalism Quarterly* that news "exists in the minds of men." He said that it's not the event but the reconstruction of the framework of that event. It means writing a news story in a way that's meaningful to the reader.

There are zillions of things newsworthy happening within amateur radio throughout the year, and many of them can be quite valuable when multiplied by news media. The unusual, dramatic, and exciting things are first choices. Hams handling emergency traffic during storms, floods, or fires make news, for example. So does a holiday traffic handling project for GIs overseas. Field days and emergency tests qualify, and so, too, does a club radio class.

Just as various bands provide hams with various degrees of "reach" for their signals, so, too, do news stories vary according to their subject matter.

Some things make good copy for your local newspaper, such as the ladies night club meeting announcement with an accompanying list of XYL committee members. Other stories have so much inherent drama that they command the attention of a wider circle of news outlets, such as the Alaskan earthquake traffic handled by hams.

Before contacting the press about important ham happenings it's important to organize the facts. If the event is one in which you're a participant, the job is easy. Otherwise, you've got to gather the facts from others before writing up the event.

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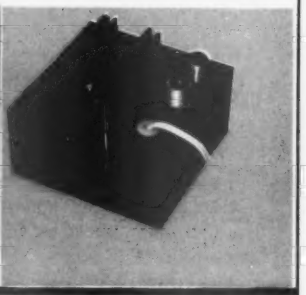

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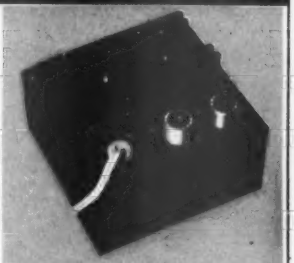

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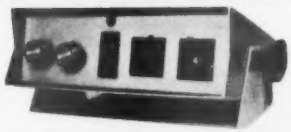

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(305) 844-1323

For the radio club publicity chairman this means legwork or landline calls, although the job can be made much simpler if he publicizes his telephone number in the club bulletin so that members automatically call when things happen.

After securing the facts, the task is in organizing them in a logical manner in a news release. The key here is in following proper form and style so that the information is in familiar, ready-to-use format. Editors are human, and giving them something requiring little or no major translation or rewrite may result in publication instead of the circular file.

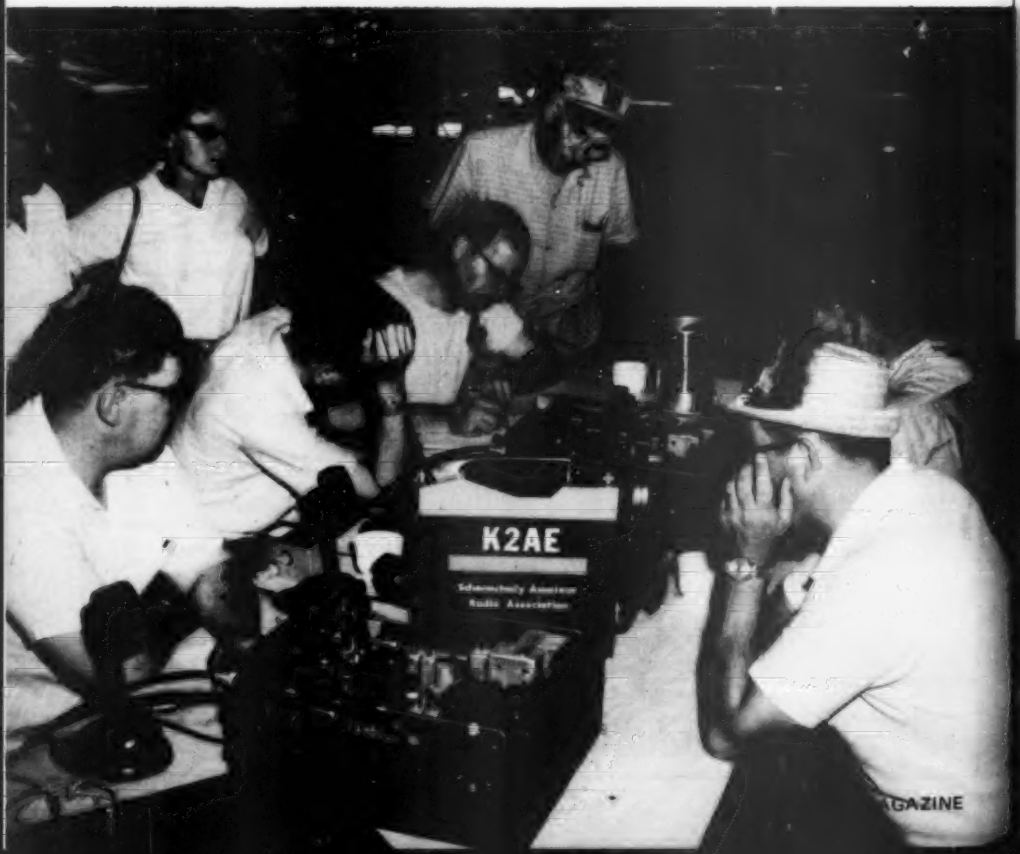
Most news releases contain the same basic elements: some heading designating the issuing organization or individual, a release time if it's dated material, a date of issue, contact information, and the actual news matter.

Taking it from the top, a letterhead is usually the best vehicle for carrying news, since it adds an air of authenticity to the document. Radio club stationery is ideal for the job. If you're not representing an organization or can't get a letterhead, you can use white bond. In either case, type the words *News Release* across the top or flush with either right or left margins.

Next, date the release. This means the date you're issuing the information and not necessarily the date of the event mentioned in your text. On current, topical news items type the words *For Immediate Use* which indicates that yours is dated information.

This news photo catches the action of the radio amateurs' role in supplying communications for the Albany to New York Outboard Motorboat Race. Hams provided communications over the entire 155-mile route via 75 meter SSB and 2 meter FM via repeater. Note the identifying sign positioned in the scene. Such public service activities are good newsmakers.

Photo: W1DQO



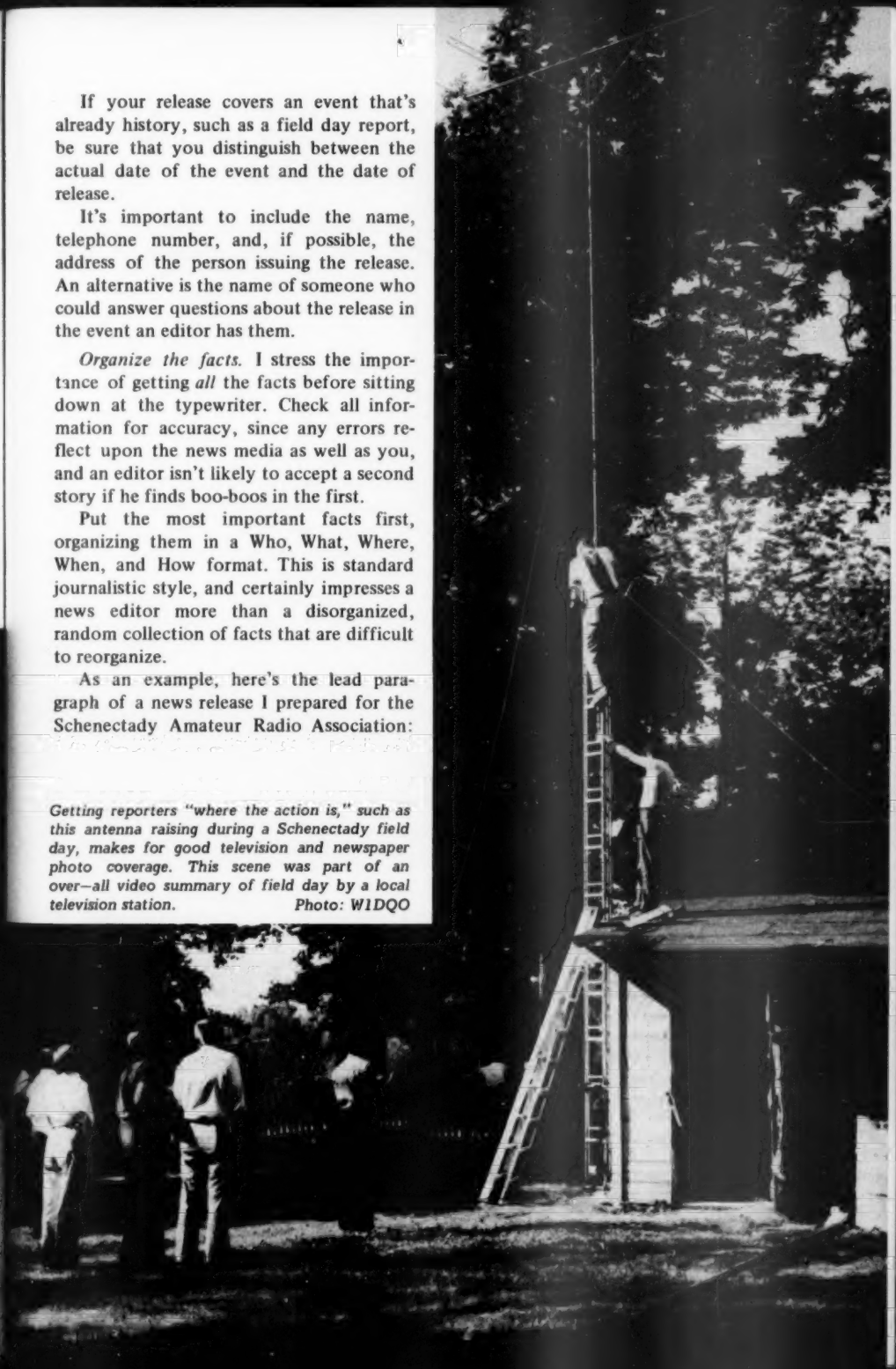
If your release covers an event that's already history, such as a field day report, be sure that you distinguish between the actual date of the event and the date of release.

It's important to include the name, telephone number, and, if possible, the address of the person issuing the release. An alternative is the name of someone who could answer questions about the release in the event an editor has them.

Organize the facts. I stress the importance of getting *all* the facts before sitting down at the typewriter. Check all information for accuracy, since any errors reflect upon the news media as well as you, and an editor isn't likely to accept a second story if he finds boo-boos in the first.

Put the most important facts first, organizing them in a Who, What, Where, When, and How format. This is standard journalistic style, and certainly impresses a news editor more than a disorganized, random collection of facts that are difficult to reorganize.

As an example, here's the lead paragraph of a news release I prepared for the Schenectady Amateur Radio Association:



Getting reporters "where the action is," such as this antenna raising during a Schenectady field day, makes for good television and newspaper photo coverage. This scene was part of an over–all video summary of field day by a local television station. *Photo: W1DQO*

"More than 150 Schenectady amateur radio operators will participate in a simulated emergency test this weekend as a part of a nationwide exercise conducted in cooperation with the American Red Cross and Civil Defense agencies. . ."

Following this lead paragraph, the release went on to outline additional facts and explanatory details of the story. Among them: who was sponsoring the radio activity, the reason for the emergency test, messages to be handled, and quotes from the radio chairman and local Red Cross chapter chairman.

Try to "sniff out" the most important or dramatic part of the story for the lead paragraph, and then fill in the additional facts of the story as the release goes on. Grabbing someone's attention is the first hurdle a writer faces, and it insures that more people will read it than pass over it.

The more professional-looking the release, the better are its chances of being considered for publication. Here are some of the basics:

- Type the release on good white bond, double-spacing throughout.
- Stick to the facts, avoiding opinions that seem to editorialize.
- Use plain English, good grammar, and common phrases while avoiding ham jargon that wouldn't be understood by the general public.
- Keep sentences short, and eliminate extra words – crisp style is a plus.
- Use full names and addresses when mentioning individuals. Call letters aren't too important for local use but naturally should be included in stories sent to radio magazines.
- If your town has several news media, be sure to release your news simultaneously. *Editors are irritated to spot a story in a competing news medium before they've seen it.* (Amen! – Ed.)

Including a photograph with a news story is an important "extra" that increases the chances that a story will be used. But, since the cost of preparing printing plates of photographs is considerable, editors are fussy about what they'll accept. It's got to be good!

OUTLETS TO CHECK

- Daily newspapers
- Local radio & television stations
- Weekly newspapers
- Company magazines (if your story involves employees of local firms)
- Chamber of Commerce magazines
- Amateur radio magazines
- School newspapers (if your story includes student participation)
- Major metropolitan newspapers that publish state-wide news features that include your community.

Unfortunately for most of us, this means shelling out a few bucks for a reasonably competent photographer who can come up with professional-quality prints. Polaroid shots don't make the grade.

What makes a good photograph? You can judge that by looking over some of the popular national magazines. Visual *interest* is the key. Action shots showing people *doing* something are much more desirable than the standard shot showing people lined up like phased verticals and just "standin' around not doin' nothin'."

If you're sending along a newsphoto with your story, be sure you identify it as to subject matter or in terms of "what's happening." Attach this information in a photo caption, and if there are people, identify them.

Some news events lend themselves to coverage by radio or television. Prime subjects include activities such as field day in which the action and immediacy of the moment combine to provide ideal broadcast stories. Highly visual events like antenna raising, generator checkouts, rig setup, and actual on-air situations are great on camera. If your local TV station can spare a sound camera, it would also be possible to interview the FD chairman who could explain the action and the significance of the drill. The drawback to video coverage is that most stories must be boiled down to about a minute, so every scene and every word count.

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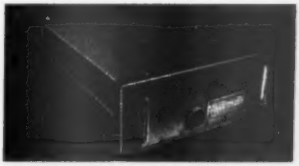
With private line minus reeds ..... $78.



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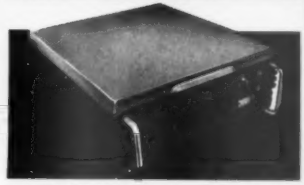

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- Special club programs
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- Radio exhibits in schools

When you approach a broadcast station, remember that most of them are quite busy and follow rather complicated logistics in setting up stories in which a cameraman is involved. So if you're interested in having them cover your event, give them plenty of advance notice. By mail, include a cover letter with your release pointing out the importance of the story and offering your help in setting up any film coverage. Don't try to shove the story down the throat of a news editor, however. Editors decide if the item is going to fit their schedule, and even if they don't agree to do a film story they may still mention it in their newscasts.

Give the press a "Fact" sheet. Busy editors are willing to learn about your organization, but they want the basic facts boiled down to a few clearly written paragraphs. In short, the "nitty gritty" of it all. A typical fact sheet could contain the following elements:

- Why your organization was organized, hopefully stressing the public service aspects of amateur radio.
- Where your organization is located, the geographic area represented by your members, and the headquarters address. Club call letters may be added where appropriate.
- Who your members are: A good spot to emphasize the fact that hams are licensed by the government only after passing stiff exams on code, theory, etc. This distinguishes the amateur radio organization from CB groups.
- How you function: Emphasize here any public service activities in which the group regularly engages, such a traffic handling, radio classes etc.
- What you've done: A summary of noteworthy accomplishments could be included if the club has been around long enough to build up a scrapbook of good deeds.

One word of warning: Remember that yours isn't the only news passing the news desk and that sometimes your story may never see print or get on the air. There's competition for news coverage, and this QRM can sometimes drive your story right out of the running!

Don't be discouraged!

Even if you've labored over a news release all evening (and missed a beautiful band opening or DX) you really haven't labored in vain. Send the story to the amateur radio magazines if appropriate, adding the call letters of those involved and any ham jargon that had to be excluded from the local version.

If your club has a bulletin, ask the editor to consider a version of your story for his next issue. Editors are always hungry for good copy!

Keep a file of all news releases. Such a file is handy in the future when writing similar stories, since the writer can refer to it for style and approach.

Thanks. When your local news media have used several of your stories, it's not a bad idea to write them a note of thanks. Editors appreciate this.

If you're the publicity chairman of a radio club, add some information as to how a newsman can reach you. Sometimes an active newspaper or broadcast station will go looking for interesting feature stories, and they may think of your group the next time they're stuck for an idea. Such things as radio classes for teenagers make good copy.

In summary, tell the story of ham radio's positive contributions, and tell it often! It's a sound way to build an equally sound public appreciation of our efforts.

Who knows? When the going gets rough, we may need this good will "savings account" more than we realize. WB2FBF■

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. . . Some notes on the . . . SWAN 350 SWAN 350 SWAN 350

Paul K. Pagel K1KXA
4 Roberts Road
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If you own a Swan 350 or are thinking of purchasing one on the used market, the ideas put forth in the following article should be of interest to you. Briefly, it is a summary of modifications I have made to my Swan 350, some of which take only moments, others which take an hour or two, but none of which are very difficult.

I've had my Swan 350 since December 1966, when I purchased it on my last trip to the famed "Radio Row" section of New York City. It has brought me many good hours of hamming, mostly on 10 meters. What a difference between it and the receiver I had been using!

Like most hams, I eventually began to think of some small modifications I would like to see in it. This urge became even stronger with the advent of the Swan 500, 350C, and the 500C, which had a few more goodies and some circuit changes not incorporated in the 350. Since I was in no financial position to buy new gear, I decided finally to dig into the Swan. My wife did not encourage this decision, to put it mildly, but I was hoping not to mess up a piece of good-running, expensive gear.

The first trip into the belly of the Swan had as its purpose the installation of components necessary to utilize the remote vfo. This will not be detailed as it is a factory modification readily available. The successful completion of this project encouraged me.

AM Reception

The next change I wanted to make was to be able to copy an AM signal without the beat note produced by the product detector when the signal drifted. On this occasion I wrote to the Swan company to inquire if they had any easy way of doing this. (Swan, by the way, has an excellent customer service representative in Mr. L. Whitley K6PKC.) The modification I received was simply to install a switch to unground the grid resistor of the carrier oscillator, R1401. The ground end of the resistor is lifted and wired to the arm of an spdt switch. One end of the switch goes to ground and the other to the terminal marked "K" on S2, the RECEIVE/TUNE switch.

I mounted my switch to the left of the PTT/VOX switch underneath the S-meter. Originally, it was mounted on the rear apron, but I soon tired of having to reach behind the rig to get at it. A miniature Radio Shack toggle switch was used. Since this requires only a small hole, it makes the

job easy and is not messy at all. When drilling the hole, it might be a good idea to use a speed control on the drill and also to centerpunch the hole location before drilling. That way you won't slip and mark up your panel meter.

In use, you may receive AM without the annoying heterodyne produced when the signal moves off frequency slightly, but you still maintain SSB *transmission* or, if you have inserted carrier, single-sidebanded AM. I have used this method of receiving AM and it works well for the purpose I intended, on a strong local signal. It does amount to forcing the signal through the product detector, however, and weak AM signals won't quite make it.

Schematic Discrepancies

In answer to one of my many requests for information, Mr. Whitley forwarded the schematic of a Swan 500, the model immediately succeeding the 350, plus Service Bulletins 9A and 10. Comparing all this information to the schematic I had in my instruction manual and checking the wiring itself, I found that the schematic in my manual did not fully agree with the particular unit I had.

On earlier model 350s, there was a wire running from pin 9, of V13, the balanced modulator over to a terminal on the RECEIVE/TUNE switch. This wire was *not* installed on later 350s. Although the wire had been removed in my unit, the schematic indicated the wire existed. The Swan people removed this wire *to reduce a spurious radiation while operating in the lower portion of the 15 meter CW band*, as quoted from Service Bulletin 9A. You can readily tell if this wire is there or not. If the wire *is* there, you will have carrier insertion simply by rotating the RECEIVE/TUNE switch to TUNE. If the wire *is not* there, you have to insert carrier with the CAR. BAL. control every time you tune up and then balance it out if you're working SSB.

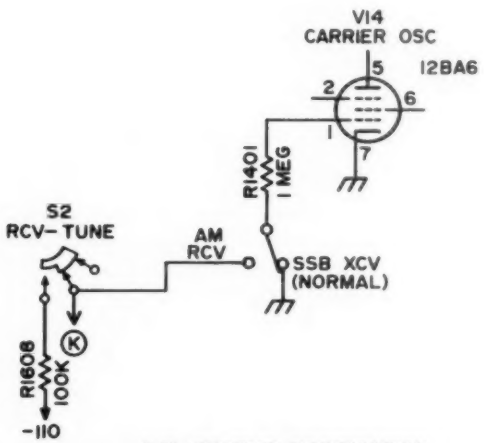

Fig. 1. This diagram shows the changes made in order to copy AM without a beat note caused by drifting of the signal. The switch is mounted on the front panel below the S-meter to the left of the PTT/VOX switch.

On earlier 350s, produced before June 1966, overheating of L306 (an rf choke in the plate circuit of driver V3) caused a loading problem on one or two bands, according to Service Bulletin 10. The bulletin states that overheating of this choke

would occur if a momentary short between the plates of the variable final grid capacitor existed. On later models, a 0.002 μF capacitor was installed between the rear

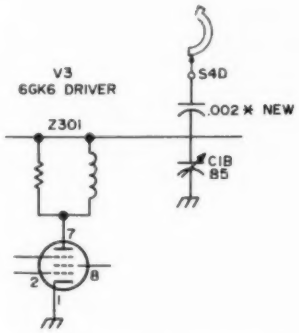

Fig. 2. This is the change incorporated by Swan on the later model 350s to prevent overheating of rf choke L306. (No connection between the junction of the capacitors and the driver plate circuit, please.)

section of the variable capacitor and switch section S4D. The fixed capacitor, although not indicated on the schematic I had, was there. You can easily tell if it is in your unit (if you're doubtful as to its age) since it's visible from the top of the chassis connected between the rear section and a nearby terminal strip with a wire going to the underside of the chassis. This capacitor was indicated on the 500 schematic I received and there labeled as C308.

While prowling through my 350, I noticed the connection for L403, the rf choke on the output end of the *pi*-network hadn't been soldered. Although I never experienced any problems because of it, and don't imagine anyone would, a touch of solder put my mind to rest. It is a safety feature. Should one of the plate-blocking capacitors C415 or C416 short, this would put 800 to 900V dc on the antenna connection. This choke insures that the fuse, circuit breaker, or power supply goes first instead of you. Its presence doesn't bother the rf going out to the antenna.

Another possible "zapper" is located on the VOX accessory socket on pin 3. It's got 275V dc on it. No, it's not for the transistors! Pin 3 is the takeoff for receiver audio for the VOX unit and is derived directly from the plate of audio output tube V12, without the use of a blocking capacitor. Since all you want, if you're using the VOX, is the audio, put a 0.05 μF ceramic in there and keep the dc off pin 3. You could use a paper or Mylar, but they're physically large.

There is an 18 MHz trap on L601 on later Swans. Again, my schematic did not show it, but it's in there. Inside you'll see a small ceramic trimmer and coil mounted on L601. The trimmer tunes the trap, not L601! It's just nice to know what the extra parts are for.

While talking of trimmers, possibly some of you have had fun looking for the 10 meter neutralizing capacitor. It's the small trimmer near the shaft end of the 20 meter neutralizing capacitor between the bandswitch and the 10 meter driver coil. A two-lug terminal strip is also nearby, which is the ground lug for the 10 kΩ, 10W resistor in the screen circuit of the finals. Remember to reneutralize the finals when you replace them with new ones.

VHF Operation

Last winter I had the urge to go on 2 meters. Since the 350 is the only receiver I have, I had to run the converter into it, using the 10 meter band as the i-f. I got tired of worrying about blowing the converter and possibly the finals if the transceiver were accidentaly keyed with the converter hooked up to the antenna jack. So, I installed a single-hole-mount BNC connector on the rear apron between the power plug and the accessory socket. The wire from the center conductor of the connector was hooked to L604 where the wire comes from K2 relay operating arm to the lug on the form of L604. This eliminates the possibility of a couple hundred watts of SSB being fed into the converter front end.

Grounding

In the early operating days of the 350, I had a few reports of hum on the carrier

when operating CW on 40 meters. My first thought was power supply problems, but this proved false. It turned out to be insufficient grounding. Although each unit was separately grounded to station ground, the addition of a length of braid between the power supply cabinet and the transceiver chassis cured the problem. A hole was drilled near the VOX socket and a bolt installed with lockwashers and a nut to keep the bolt in place. A second nut keeps the grounding braids in place.

I noticed that the rf gain control became scratchy quickly. I cleaned it, but it again started scratching after a short while. Since the following modification was made, I haven't cleaned the pot once, and that has been over a year. The sensitivity also appears to have come up, but it only *appears* that way because the rf gain control does not have to be opened as far once the modification is installed.

Independent Biasing

Balanced tubes for the finals are not always handy. In fact, I never knew Swan recommended balanced tubes until I wrote to them a while after I had the rig. Unless you have a spare pair around all the time, there may come a time when you'll have to use unmatched tubes if you want to get on the air in a hurry. (Again, Swan is terrific in filling orders promptly.) Chances are you're not going to be able to buy a matched pair locally and the guy at the store isn't going to let you run through a dozen or more testing 'em. That's why I put in separate biasing networks.

This modification takes a little more time and possibly it could be accomplished more easily by some other method, but this is the way I did it. I duplicated the existing network. Probably the hardest part was finding room for the extra parts in the already crowded chassis, but I've got it all mapped out for you so it shouldn't be much trouble at all. You'll need a dual 10 kΩ pot with concentric shafts, a 10 kΩ (1W), two 4.7 kΩ and a 1 kΩ resistor, one 200 μH rf choke or peaking coil, two 0.002 discs, and a 5 or 10 μF 150V electrolytic capacitor – plus a couple of small terminal strips.

Start by removing the bias pot from the rear apron. Disconnect the two wires and the end of R411 and push them aside temporarily. R411 is soldered to a ground lug underneath the 10W power resistors near the bias pot. Solder one end of the new 10 kΩ (1W) resistor to the same lug. Label this resistor R411b on your schematic.

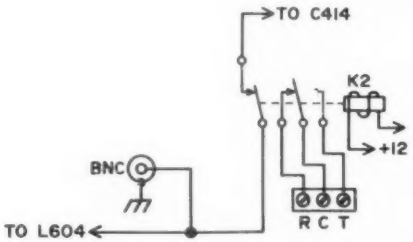

Fig. 3. The BNC connector is mounted on the rear apron between the power connector and accessory socket. This allows injection of signals from VHF converters, frequency calibrators, etc., without the possibility of damage due to accidental tripping of the transmit switch.

A small three-lug terminal strip with center-mounting lug is mounted under the mounting screw for the barrier strip carrying the auxiliary relay terminals (AUX. RELAY TERMS.). R413b, 4.7 kΩ is connected across the two above-ground terminals. On one end of this resistor, connect C406B and a wire. The wire will eventually go to the bias pot. The other end of C406B is grounded at any convenient spot. (I used the socket ring of V5 socket.) From the other end of R413b, connect R412b, 4.7 kΩ, with insulated sleeving on the leads to prevent shorting, over to pin 7 of V4, the final amplifier socket toward the front. We are going to use the inoperative pins for terminal lugs – there are no tube connections at these pins. At pin 7 of V4, connect C401b, 0.002 μF from the pin to ground. Put sleeving on the 1 kΩ resistor (R402b), and connect it from pin 7 of V4 across the socket to pin 2 of the same socket.

At this point, we must isolate the grids of the two final amplifiers as far as the bias networks are concerned yet allow rf to get to both of them. Do this by cutting the copper strap between V4 pin 5 and V5 pin 9 just enough to allow the body of a 0.002 μF capacitor to fit between the ends of the straps. This capacitor would correspond to C318, so call it C318b. Solder one lead to V4 pin 5 strap and the other to V5 pin 9 strap. Also from V4 pin 5, solder one end of the 200 μH rf choke L404b; the other end goes to V4 pin 2. Try to keep all leads as short as possible.

To insert the dual pot in the chassis hole, it may be necessary to temporarily unsolder one or two of the 10W power resistors. Mount the dual pot and connect the bottom ends of the pots to their respective resistors (R411 and R411b). The wire, white/yellow/green, that was removed from the old bias pot can now be replaced on the center wiper contact of one of the pots and the wire from R413b goes to the other pot center lug. The −110V dc line should be connected to both of the upper lugs on the pots. This completes the modification.

But how, you ask, do you adjust the bias values individually without the aid of a switchable plate current meter? If you pull one tube out, the other will be dead since the filaments are in series. And who wants to stick another meter in there, even externally? Well, if you've stuck with us this far, hang in there 'cause we're going to get to the switchable current meter in the next modification. Temporarily I used an old 6HF5 with good filaments, cut off all the other base pins and used it to complete the filament circuit without drawing cathode current. Sneaky . . . Now you can remove one of the finals, put in the dummy tube, set the idling current with the associated bias pot, remove the operating final from its socket, substitute the dummy tube, put the other tube in its appropriate socket and adjust its bias with its pot. For a check, try inserting carrier to a given level, say 100 mA, and see how the two tubes track for a given setting of CAR. BAL. If they're within 10%, you should be okay. If you check the bias voltage on the two tubes while you're doing the idling current adjustments, you should see a difference in the amount of bias required for a given idling current level if the tubes are unbalanced. If the values of bias voltage are close, the tubes are probably pretty close to being matched in the first place, but chances are you'll see a significant difference. Even balanced tubes won't track exactly 100% over the full range of currents.

The ability to monitor the current of each of the final amplifiers separately can

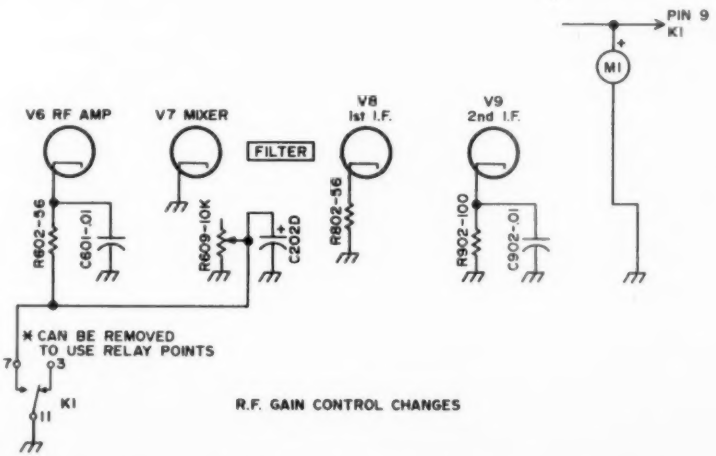

Fig. 4. This eliminates frequent rf gain control scratchiness and gives apparent sensitivity increase.

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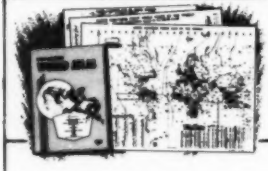

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be accomplished without too much trouble. Since I wanted this convenience, I decided to take the following approach. It has a side benefit in that it allows reading the currents twice as accurately.

By referring to the schematic, you will notice the cathodes of the final amplifiers are connected in parallel, going to ground through two resistors, R408 and R409, both 1Ω (5%) resistors. These resistors are here simply to provide a voltage drop to be read by the 0–1 mA meter used as the combination S-meter and cathode current meter. In this instance, the meter is used as a voltmeter with multiplier resistors R406 and R405. R406 is a 470Ω resistor while the value of R405 is not specified, but in my case is 1.5 kΩ.

Conveniently, resistors R408 and R409 are mounted so that one is at each final amplifier tube socket and not immediately adjacent to one another or tied together. This makes the job easier. Cut the copper strap between pin 4 of V4 and pin 10 of V5. This separates the cathodes of the two tubes from each other but leaves R408 at one socket and R409 at the other. Attach a wire to pin 4 and another to pin 10 of V4 and V5. These are to be routed neatly around the chassis to the front panel to a spot underneath the S-meter where the switch will be mounted.

R405 and R406 are unsoldered from the cathode strap formerly joining the two tube cathodes and this junction of the two resistors is soldered to pin 7 of V5 along with a wire which will also be routed to the S-meter location for connection to the center pole of an spdt switch.

If you remember the AM modification, a switch was placed on the left side of the PTT/VOX switch (facing the rig in a normal operating position). Now we will put the other switch to the right of the PTT/VOX switch to balance the layout. Again, a miniature toggle switch is used. This time, however, the meter will have to be removed to get your fingers in a working position. (The mounting screws are underneath the nameplate which is held on by an adhesive backing.) You will also have to remove the tubes immediately

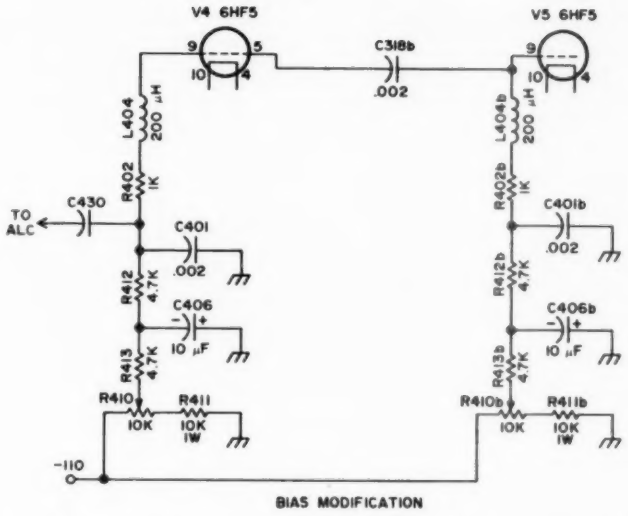

Fig. 5. This allows adjustment of the bias on each tube individually and permits the use of unbalanced tubes in an emergency.

behind the meter. The switch is installed in the same manner as previously described. Here, the switch was installed with the center slightly to the right of center of the letter "O" in VOX. The mounting washer

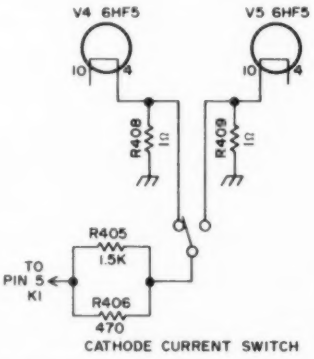

Fig. 6. Hookup allowing monitoring of individual tube cathode currents. The switch is mounted on the front panel underneath the S-meter to the right of the PTT/VOX switch.

that comes with the switch covers the word "VOX" neatly. Now, wire up the switch and then insert it into the hole, replace the meter, tubes, and nameplate and you're all set.

Note here that the meter reading will be the *same* as before, even though you're only measuring the cathode current in one tube. Though the current has been halved (one tube current instead of two), the resistance (R408 and R409) has been effectively doubled, so the voltage being read by the meter remains the *same*. Therefore, when you're setting the idling current, for example, an *indication* on the meter of 50 mA is *actually* only 25 mA, but is nevertheless *correct* for the single tube. Throwing the switch in the other direction to read the other final's current should indicate the same thing once the bias has been adjusted. Really, you don't have to worry about halving the meter readings; read the meter as you normally would.

With a dummy load hooked up, switch to read V4 current. Adjust the bias control for V4 to indicate 50 mA. Switch to read V5 and adjust bias similarly. Now, depress the PTT switch on the mike and insert carrier with the CAR. BAL. control until the meter reads 150 mA as before the modification. Throw the switch back to V4 and check the current there. It should be

within 10%. Load, null the carrier, and modulate, keeping the meter at 150 to 200 mA on intermittent peaks in accordance with the instruction manual. As you can see, the operation remains the same. The meter is showing 150 to 200 mA on the peaks, but actually since only one tube current is being measured, the current is 75 to 100 mA. The nice thing about this is, you can tell if one of the tubes has pooped out simply by throwing the switch. You won't have to worry about one bottle doing all the work while the other loafs along, the working tube gradually taking on the appearance of a large maraschino cherry.

AVC Control

How about an avc on/off switch? Very easy to do. Just install a single-pole switch with one end connected to ground and the other to pin 6 of V11, the agc amp/detector. Here, the switch is a push-pull type which is part of the rf gain control. The original rf gain control was removed from the rig and a 10 kΩ pot with the switch section installed originally to be used with a 100 kHz calibrator. The calibrator did not satisfy me as far as long-term stability was concerned and was removed. The switch was then put to use as the avc on/off switch. It might well be used for some other purpose.

Break-In CW

There is yet another modification which I have installed in my unit which came directly from the Swan folks. This particular one is the "break-in CW" modification. This can be obtained directly from Swan and I will not go into the detail of it here. One thing I will mention, however, as pointed out in the factory mod sheet, is the fact that the VX-2 VOX unit is used directly when this change is installed, but the VX-1 unit can very easily be updated to the VX-2 unit simply by adding a wire from the 2N1302 transistor (Q5) to pin 5 of the VOX unit plug.

Possibly some of you have been troubled with the VOX unit triggering from the speaker "pop" on relay dropout. This would be more prevalent if the mike were not unidirectional. If you have made the modification removing the i-f's from the rf gain control line, terminals 3, 7, and 11 of relay K1 are actually freed from duty. These points could be used to switch the normally grounded side of the speaker output transformer. I have not tried it, so cannot vouch for its effectiveness. What I did, though, was to modify K2. Unfortunately, when K2 was manufactured on this series 350, the unused points were not supplied and there are simply slots in the insulating material where they normally

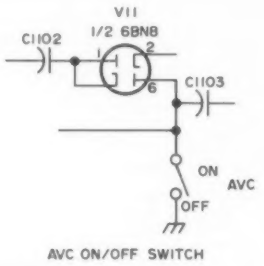

Fig. 7. A simple way of adding an avc on/off switch to the 350 or later models.

would be. So, I cut a point from an old relay I had lying in the junkbox and tapered the tail of it (the end away from the point contact) to fit snugly in the slot in the insulating material. This was done with a file, a bit at a time. It was then put into the slot from the armature end, leaving enough tail protruding on the far side to fasten a wire and solder to it. The homebrew point was secured with a glob of epoxy. Now, no "pop" is heard from the speaker on relay dropout.

Another quick change. A 25 μF 25V electrolytic from the mike jack tip connection to ground helps dull the "pop" on pickup. That was stolen from the Swan 500 schematic.

That's about it. It seems that it took a heck of a lot less time to do all these modifications than to write them up! Hopefully, it may help some of you fellas who have owned a 350 for a while and some who may have picked them up or are planning to, on the used market.

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- ☐ Cornell 109
- ☐ Crawford 84
- ☐ C.T. Power 17
- ☐ Dahl 22
- ☐ DyComm 45, 89
- ☐ DXers 58
- ☐ EKY Video 58
- ☐ Epsilon 74
- ☐ Freck 84
- ☐ Gateway 99
- ☐ G&G 51
- ☐ Goodheart 109
- ☐ Gregory 93
- ☐ Hal 47, 106
- ☐ Hale 78
- ☐ Henry 17, 18, 19
- ☐ Hi-Par 109
- ☐ H&L 109
- ☐ James 109
- ☐ Jan 60
- ☐ Janel 109
- ☐ Jefftronics 99
- ☐ K-Enterprises 47, 78
- ☐ Lewispaul 106
- ☐ Mann 100
- ☐ Mosley 70
- ☐ National 27
- ☐ Notre Dame 47
- ☐ Pagel 74
- ☐ Paradd 109
- ☐ Park Elect. 78
- ☐ Payne 22
- ☐ Pearce Simpson Cover III
- ☐ Pickering 58
- ☐ Poly Paks 111
- ☐ Regency 33, 34, 35, 36
- ☐ Regency HR2S
- ☐ Regency HR2MS
- ☐ Regency HR2-A
- ☐ Robby's Radio 22
- ☐ R.P. Electronics 64
- ☐ Saroc 78
- ☐ Schober 58
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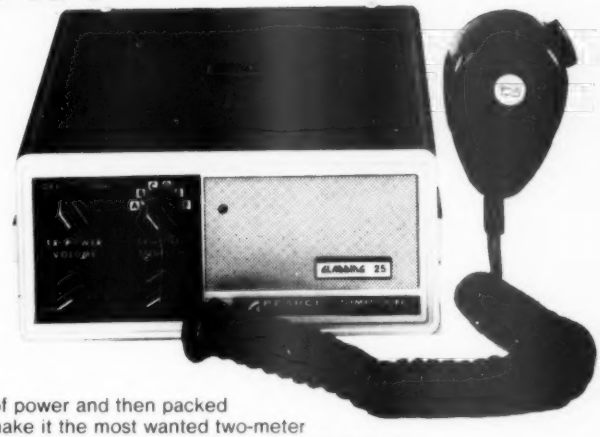
England	7	7	7	7	7	7	7B	14	21	21	14	7B
Hawaii	21	14	7B	7	7	7	7	7	14	21	21A	21A
India	7B	14B	7B	7B	7B	7B	7B	14	14	7B	7B	7B
Japan	21	14	7B	7B	7	7	7	7	7	7B	7A	14A
Mexico	14A	7	7	7	7	7	7	14	14A	21	21	21
Philippines	21	14	7B	7B	7B	7B	7B	7	14	14	7B	14A
Puerto Rico	21	7A	7	7	7	7	14	21	21	21	21	21
South Africa	14	7	7	7	7B	7B	14	21	21	21A	21	21
U.S.S.R.	7	7	7	7	7	7B	7B	14	14	14	7B	7B

WESTERN UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
Alaska	21	14	14	7	7	7	7	7	7	14	14A	14A
Argentina	21	14	14	7	7	7	7B	14A	21A	21	21	21
Australia	21A	21A	21	14	7	7	7	7	14	14	21	21
Canal Zone	21	14	7	7	7	7	7	14A	21	21A	21A	21
England	7B	7B	7	7	7	7	7B	7B	14	14A	14	7B
Hawaii	21A	21	21	14	7	7	7	7	14	21A	21A	21A
India	14	14	7B	7B	7B	7B	7B	7B	14	14	14	7B
Japan	21	21	14	7B	7	7	7	7	7	7B	14	21
Mexico	21	14	7	7	7	7	7	14	21	21	21	21
Philippines	21	21	14	7B	7B	7B	7B	7	14	14	14	21
Puerto Rico	21	14	7	7	7	7	7	14A	21	21	21	21
South Africa	14	14	7	7	7B	7B	7B	14	21	21	21	21
U.S.S.R.	7B	7	7	7	7	7B	7B	7B	14	14	7B	7B
East Coast	21	14	7	7	7	7	7	14	21	21	21A	21

A = Next higher frequency may be useful also.
B = Difficult circuit this period.

25 Watts isn't everything, but with everything else it's GREAT!



GLADDING 25™

- 25 WATT • FM
- 6 CHANNEL
- 2 METER
- TRANSCEIVER

We loaded this rugged, new, two-meter radio with 25 watts of power and then packed it with desirable features that make it the most wanted two-meter amateur radio on the market. It's the Gladding 25™ from Pearce-Simpson, Division of Gladding Corporation and the World's largest manufacturer of marine communications equipment. Best of all, because of our unmatched marine volume, we could add a price tag to it that can't be matched by anyone, anywhere, and still give it custom quality. Great! 25 watts and a lot more, from Pearce-Simpson.

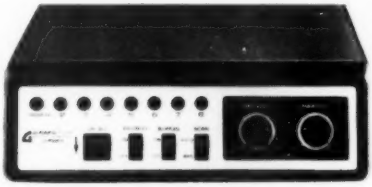
• 25 watts output • 0.3uv sensitivity for 12db SINAD • built in 12 volt power supply • matching AC power supply accessory • 6 separately switchable transmit and receive channels • Economical vacuum tube driver and final.

• Plus • 8 pole crystal lattice filter • Transistor sockets • Glass epoxy printed circuit boards • Quick disconnect power plugs • Mounting cradle • 1 watt output switch

$249.95 mobile unit

$295.95* with accessory AC Power Supply

Suggested List Price



GLADDING HI-SKAN™

8 Channel VHF Monitor

• Automatically scans 8 preselected channels • Switch for manual selection of channel • Priority channel • Bypass channel • 115VAC/12VDC built in power supply • Mounting cradle • Can be tuned to 2 meters.

$99.95*

*Suggested List Price

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DIVISION OF GLADDING CORPORATION
P.O. Box 800, Biscayne Annex, Miami, Florida 33152

YOU'VE READ ABOUT IT...

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RECEIVE ANY FREQUENCY IN THE 2M BAND (146-147 MHz) WITH 2 SIMPLE SETTINGS ON THE NEW CLEGG FM-27 MOBILE WITH THE MIRACLE CRYSTIPLEXER*

*Trademark

The new solid state Clegg FM-27 features Crystiplexer, the unique frequency synthesizer in its receiver that spots any frequency in the 2M band with crystal accuracy . . . *but without using additional crystals.* Transmitter section has a power output of 22 watts minimum. Check these specs:

- *10* crystal controlled transmit channels 2 crystals furnished in Crystiplexer.
- Speech processing for low distortion—high talk power.
- Better than 0.35μV receiver sensitivity for 20 dB of quieting with 70 dB adjacent-channel attenuation.
- Weighs less than 3 pounds.
- Compact . . . only 3½" H. x 7⅞" W. x 9¾" D.
- Housed in rugged, anti-theft case with special locking-clamp mounting.

SIGNAL AND CONTROL INTERNATIONAL CORPORATION

Clegg DIVISION

ALL AMERICAN-BUILT EQUIPMENT FOR THE HAM 2 METER WORLD

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EAST

CONN., Hartford	Hatry Electronics
CONN., Waterford	Satellite Amateur Radio
MD., Wheaton	Electronic Distributors, Inc.
MASS., Reading	Graham Radio
N.H., Concord	Evans Radio, Inc.
N.J., Totowa	Arrow Electronics
N.C., Lexington	Everhart Electronics
N.Y., Farmingdale, L.I.	Harrison Radio
N.Y., New York	Arrow Electronics
N.Y., New York	Harrison Radio
PA., Pittsburgh	Whiteside Electronics
PA., Willow Grove	"Ham" Buerger

CENTRAL

ILL., Genoa	Crawford Electronics
ILL., Peoria	Klaus Radio & Electric Co.
IOWA, Council Bluff	World Radio Laboratories
MICH., Ann Arbor	Purchase Radio Supply
MICH., Detroit	Radio Supply & Engineering
MO., St. Louis	Ham Radio Center
OHIO, Cleveland	Communication World
OKLA., Oklahoma City	Bob's Discount
S.D., Watertown	Stan Burghardt
TEXAS, Dallas	Electronic Center, Inc.
WIS., Madison	Satterfield Electronics, Inc.
WIS., Milwaukee	Amateur Electronic Supply

WEST

CALIF., Los Angeles	Henry Radio, Inc.
CALIF., Oakland	Amrad Supply
COLO., Denver	C-W Electronics Sales